INTERACTIONS OF IMPLANT RESPONSE WITH GENDER, AGE, AND ANIMAL TYPE

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ABSTRACT

The potential for the variables of age, gender, and animal type to interact with implants is a legitimate concern of beef production. Research testing interactions is limited because the process of product approval by FDA requires specific tests within target animal groups of a single type. Yet, evidence indicates that interactions do exist. Privately held data indicate that compared with older animals, younger and smaller animals require a smaller effective dose of estradiol (E_2) to maximize growth. The literature we have reviewed indicates that effectiveness of compounds diminishes as cattle approach mature BW. Relative growth responses to E_2 (percentage of control) appear similar between suckling steer and heifer calves but the implant response is sensitive to the growth potential of the cattle. Only after puberty, do differences in response between steer and heifer appear. Postpubertal steers and ovarietomized heifers are more responsive to E_2 than are heifers. Steers are less responsive to trenbolone acetate (TBA) than are heifers. Genotype in general does not appear to interact with implant type beyond the involvement of inherent productive capability.

INTRODUCTION

Our overall approach to examine the potential interactions between implants and gender, age, and animal type has been less than systematic. We found a few examples where it was possible to pool sufficient data to draw comparisons with confidence. Other examples discussed should be considered only as cursory or preliminary observations. In these instances, more research is needed.

When we consider intact vs castrate animals males (2 classes) vs females (2 classes), calf vs yearling (2 classes), and animal type as large or small framed, typical or heavily muscled, typical or high marbling (6 types), we have 48 factors. If these animal factors are tested across four classes of implants (none, estradiol (E_2), trenbolone acetate (TBA), or estradiol + trenbolone acetate), we have 198 comparisons to make. Trials replicated across three locations with 10 replicate pens at each location culminated in 5,940 pen observations for this summary. The scope of this assignment rivals the most memorable of animal breeding projects.

Age

Implant comparisons across age inevitably are confounded with BW, plane of nutrition, season, and puberty. Absolute rates of production vary dramatically due to these confounding factors. We pooled

Table 1. Response by steers to implants as a percentage of non-implanted controls

	Pooled trials with various implants [a]		E_2TBA-E_2TBA Reimplant studies [b]		Holsteins Steroid [c]	
	Calf	Yrlg	Calf	Yrlg	Light (900 lb)	Heavy (1100 lb)
ADG, %	18.0	20.6	22.3	22.4	14.6	-15.3
DMI, %	5.5	4.3	8.2	3.1	–	–
F/G, %	-10.3	-13.8	-11.4	-15.9	–	–

[a] Trenkle, 1993.
[b] Pooled ISU-SDSU data.
[c] Rust, light and heavy denote initial BW.

comparisons of calf-fed and yearling steers; responses are reported as a percentage of non-implanted controls in Table 1. In the two data sets comparing calves and yearlings, the response in DMI (%) was numerically greater in calves. Proportional changes in ADG were similar (when using E_2/TBA) but slightly favored yearlings when considering only E_2 implants. Regardless of the implant type, feed/gain was more favorably affected in yearling steers than steer calves. There would, however, appear to be an upper limit on age/BW at which cattle will respond to implants. Rust (1997) observed that Holstein steers started on feed at 900-lb responded to E_2 implants while 1100-lb Holsteins did not (Table 1).

In another Michigan study (Main, 1990), effects of puberty status (age), ovary status, and implants were compared (Table 2). Effects of implants and ovariectomy differed with pubertal status of the heifers. The Heiferoid implants increased DMI ($P < .05$) by 1.8 and 13.0% for prepubertal and pubertal heifers, respectively. However, implants provided a greater improvement ($P < .08$) in feed efficiency in prepubertal, ovariectomized heifers than in pubertal, ovariectomized heifers. Weight gains and quality grade were similar among treatments. Implants reduced yield grade ($P < .01$) and fat gain per day ($P < .10$) in prepubertal heifers but had little effect in pubertal heifers. Even though it was not changed significantly, implants numerically increased daily protein gain in prepubertal but not pubertal heifers. In summary, pubertal status or age appeared to influence the responses of heifers to implants. Results from this study indicate that implants tend to increase intake and thereby increase deposition of the primary tissues being deposited at the time. Consequently, younger animals would tend to respond to implants by increasing protein deposition, whereas older animals would deposit more fat.

Ovariectomized Heifers

Six studies (1,468 heifers; Table 3) have been reported in the literature that compared the use of implants with ovariectomized heifers. The pooled results from the six studies were subjected to statistical analysis; weighted, least square means were generated (Table 4). Growth promoting implants increased ADG by 10.5 and 15.7% for intact and ovariectomized heifers, respectively, when compared to control heifers. Implants increased DMI by both intact and ovariectomized heifers. However, the increase was much larger by ovariectomized heifers ($P < .10$). As a result, feed conversion efficiency was numerically improved by 1.0 and 3.0%, respectively, by the use of an implant in intact and ovariectomized heifers. Yield grade and marbling were not significantly changed by implants. This observation is supported by another summary in this proceedings from a larger data base which concluded that marbling was not negatively affected by use of implants in heifers (Duckett et al., 1997).

Breed Type

Several studies are available for comparing implants across breed types. In the largest of these experiments, Preston et al. (1995) compared English, Continental, or Brahman influenced breeds and revalor-S, Implemax-H, and Synovex-S implants. The lack of breed type x implant interactions for the variables ADG, F/G, or hot carcass weight indicated that these compounds had comparable effects across breed types.

Perry et al. (1991) compared non-implanted and implanted (revalor-S) steer performance across Holstein, Angus, or Simmental by Angus breed types. They observed that implants increased ADG, DMI, and gain/feed within each breed. Potential interactions were not tested in these steers harvested at a constant rib fat depth endpoint. However, the percentage response calculated from their data would indicate that beef breeds were more responsive to implants than Holsteins. McEwen (personal communication) reported that ADG was increased by 20.0 and 23.7% by implanting Holstein and Limousin steers, respectively.

In another interesting study, Wardynski et al. (1990) evaluated the influence of implants on the preweaning growth rate of unselected Herefords, Herefords selected for yearling weight, Angus by Shorthorn, and Simmental by Gelbvieh by Holstein steer calves. An interaction between implant response over non-implanted controls and biological type was apparent (Table 5). The increased ADG due to implanting appeared to widen as milk production potential of the breed types was increased.

Gender

Steer-heifer comparisons are clouded by the fact that only Ralgro, Synovex-C, and Compudose implants are common across genders. We were able to pool suckling calf data from two trials (Gill et al., 1984; Mader et al., 1992). The percentage of response to implant was affected more by year than by gender (Table 6). Overall, preweaning growth response to implants averaged 6.1 and 7.0% for steers and heifers, respectively.

Table 2. Effects of puberty status, ovary status, and implants on performance and composition of growing-finishing heifers

Treatment	ADG, lb	DMI, lb/d	Feed/Gain	Marbling	Yield grade	Protein gain, g/d	Fat gain, g/d
Prepubertal							
Intact-Control	2.42	16.85	6.94	13.8	2.95	84.2	689.6
Intact-Implant	2.22	15.71	6.99	12.9	2.22	100.2	588.2
Ovx-Control	1.94	15.33	7.87	15.0	2.69	76.5	581.3
Ovx-Implant	2.49	17.05	6.85	13.3	2.31	91.3	580.6
Pubertal							
Intact-Control	2.20	16.30	7.41	14.7	2.42	92.7	629.6
Intact-Implant	2.55	17.56	6.90	13.3	2.57	90.5	690.5
Ovx-Control	1.89	14.19	7.52	15.3	2.87	72.9	580.4
Ovx-Implant	2.33	16.90	7.19	13.4	2.77	82.8	582.3
SEM	.06	.26	.004	.4	.16	7.7	35.6
Probability							
Pub*Ovx	NS	NS	NS	NS	.10	NS	NS
Pub*Imp	NS	.05	NS	NS	.01	NS	.10
Pub*Ovx*Imp	NS	NS	.08	NS	NS	NS	NS

Table 3. Studies concerning ovariectomy and growth-promoting implants on performance of growing-finishing heifers

Author	Year	Location	No. of animals
Nygaard & Embry	1966	South Dakota	94
Yamamoto et al.	1978	Colorado	118
Rupp et al.	1980	Colorado	679
Rush & Reece	1981	Nebraska	170
Main	1990	Michigan	336
Garber et al.	1990	Idaho	71

A large steer-heifer feedlot comparison (2,400 cattle, three locations) also was available (Herschler et al., 1995). A 1:5 ratio of E_2:TBA produced a response in heifers that was 70% as great as the response by steers (Table 7). When the E_2/TBA ratio widened to 1:10, the additional ADG response was greater for steers than for heifers. While the 1:10 ratio did not lead to proportional increases in ADG among heifers, it lowered the percentage of choice carcasses. As expected, heifers responded better to TBA alone than did steers; steers tended to have a greater response than heifers when only E_2 was used.

Mader et al. (1992) provided one of the few lifetime implant comparisons for steers and heifers. Among heifers, implants increased weaning weight by 28 lb and a finished weight by 44 lb. Among steers, implants increased weaning weight by 22 lb but the finished BW advantage of implanted steers was only 20 lb. The BW added prior to weaning accounted fully for the weight advantage of implanted steers.

These data indicate that mitigating factors affect implant responses. Suckling steer and heifer calves probably respond similarly to implants, but postpubertal responses differ between sexes. This may relate to the condition that implants drive DMI. Consequently, the primary tissue being deposited at the time of implanting may be the tissue most affected by the implant. As lean and adipose growth and development change with age, sex, or BW, we can use this logic to infer how animals will respond to a specific implant strategy. However, these inferences may be tempered by the growth potential of the cattle involved.

Table 4. Effects of ovariectomy and implants on weight gains of growing-finishing heifers (weighted least square means)

	Intact		Ovariectomized		Probability		
Item	Control	Implant	Control	Implant	Implant	Ovary	Imp*Ovx
No. of heifers	293	438	293	444	–	–	–
ADG,lb/d	2.93 ± .40	3.2 ± .33	2.79 ± .40	3.24 ± .33	.90	.32	.84
DMI, lb/d	17.1 ± .50	17.6 ± .50	16.1 ± .50	18.3 ± .40	.95	.01	.10
Feed/gain	7.38 ± .30	7.34 ± .30	7.79 ± .30	7.56 ± .30	.30	.66	.75
Yield grade	2.87 ± .30	2.79 ± .22	3.01 ± .25	2.77 ± .22	.83	.51	.76
Marbling	582 ± 28	551 ± 25	588 ± 28	552 ± 26	.88	.25	.94

[a] 500 = small; 600 = modest.

Table 5. Effects of implant treatments and breed types on preweaning gain of suckling calves

	Suckling phase ADG, lb		
Breed type	Control	Compudose	Synovex-S
Unselected Herefords	1.43	1.45	1.47
Selected Herefords	1.76	1.87	1.85
Hereford by Angus by Shorthorn	2.13	2.29	2.27
Simmental by Gelbvieh by Hosltein	2.20	2.44	2.46

SEM = .04.

Table 6. Implant responses among suckling steer and heifer calves[a]

		% increase in suckling ADG	
Experiment	Implant	Steer	Heifer
1	Synovex-C	7.6	6.0
2	Synovex-C	5.3	8.2
3	Synovex-C	6.3	6.5
4	Ralgro	5.0	7.2

[a] Derived from Gill et al. (1984) and Mader et al. (1992).

Table 7. Implant responses by feedlot steers and heifers[a]

Implant as E_2/TBA		20/70	40/140	60/210	14/100	28/200	42/300	0/300	60/0	SS[b]
		% change from non-implanted controls								
ADG	Steer	13	16	14	18	21	23	5	12	15
	Heifer	9	11	10	12	11	16	8	9	10
Feed:gain	Steer	-3	-7	-7	-8	-11	-12	-6	-6	-6
	Heifer	-5	-5	-6	-7	-7	-9	-7	-5	-6
Choice	Steer	-14	-27	-30	-8	-29	-30	-12	-14	-17
	Heifer	-6	-21	-17	-17	-32	-34	-11	-10	-11

[a] Derived from Herschler et al. (1995).

[b] Synovex-S.

LITERATURE CITED

Duckett, S. K., F. N. Owens, and J. G. Andrae. 1997. Effects of implants on performance and carcass traits of feedlot steers and heifers. In: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma Agric. Exp. Sta. Rep. MP (In Press).

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. 68:1469-1475.

Gill, D. R., K. L. Apple, K. C. Barnes, B. L. Peverly, A. L. Hutson, G. M. Provence, and H. R. Spires. 1984. Synovex-C or Ralgro implants for nursing calves. Oklahoma Agric. Exp. Sta. MP-116:140-143.

Herschler, R. C., A. W. Olmsted, A. J. Edwards, R. L. Hale, T. Montgomery, R. L. Preston, S. J. Bartle, and J. J. Sheldon. 1995. Production responses to various doses and ratios of estradiol benzoate and trenbolone acetate implants in steers and heifers. J. Anim. Sci. 73:2873-2881.

Mader, T., S. Dahlquist, R. Stock, M. Sindt, T. Klopfenstein, and M. Lewis. 1992. Feedlot cattle response to Synovex-C in suckling calves. Nebraska Agric. Exp. Sta. MP-25:27-29.

Main, D. G. 1990. The effects of ovariectomy, growth promotants and pubertal status on performance of growing and finishing beef heifers. M. S. Thesis, Mich. State Univ.

Nygaard, L. J. and L. B. Embry. 1966. Response of spayed and non-spayed heifers to diethylstilbesterol and Synovex implants. 10th Ann. Beef Cattle Field Day, S. Dak. State Univ., Brookings. Ser. 66-13, Vol 13, pp. 70-74.

Perry, T. C., D. G. Fox, and D. H. Beerman. 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. 69:4696-4702.

Preston, R. L., D. U. Thomson, 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 Agric. Exp. Sta. Technical Report No. T-5-356:55-58.

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 steer types. South Dakota Agric. Exp. Sta. Beef Report Cattle 90-11:38-41.

Rupp, G. P., M. C. Shoop, C. V. Kimberling, B. W. Bennett, and J. Coakley. 1982. The effects of implants and spaying on feedlot heifers. Unpublished data.

Rush, I. G. and P. E. Reece. 1981. Spaying and implanting growing and finishing heifers. 1981 Beef Cattle Report. Nebraska Coop. Ext.Serv. ED 81-218. pp 35-38.

Rust, S. R. 1997. Update on strategies to utilize implants successfully. Michigan Agric. Exp. Sta. A. S. Mimeo 363.

Trenkle, A. H. 1993. Summary of implant strategies for finishing steers. Iowa Agric. Exp. Sta. AS-622:171-175.

Wardynski, F. A., S. R. Rust, H. D. Ritchie, and B. B. Bartlett. 1990. Growth implants for suckling calves. Michigan Agric. Exp. Sta. Beef Cattle, Sheep, and Forage Res. Rep. 491:70.

Yamamoto, H., J. K. Matusushima, C. V. Kimberling, and G. P. Rupp. 1978. Effects of spaying and Ralgro implants on growing and finishing heifers. Beef Nutrition Research. Colorado State Univ. Exp. Sta. General Series 979. pp. 13-14.