Implants and Their Use in Beef Cattle Production

Ryan Reuter
Range Beef Cattle Nutritionist

Gant Mourer
Assistant Extension Specialist

David Lalman
Beef Cattle Specialist

Chris Richards
Beef Cattle Specialist

The term "implant" is used to refer to a group of products used in the cattle industry that increase the rate and efficiency of growth, both metabolic and economic. Implants contain natural or synthetic anabolic compounds that produce physiological responses in the animal, similar to natural hormones. Implants are typically made of a powder that is compressed into a small pellet. The pellet is placed, or implanted, under the skin on the backside of the animal's ear. Each type or brand of implant has a specific applicator, referred to as an implant gun, which is used to properly administer the implant.

Current Use of Implants

Implants have a long history of use in the beef cattle industry. The first commercial implant was introduced in 1957. Since that time, the use of implants has been widely adopted by the cattle feeding and stocker sectors of the beef industry. According to a 2011 NAHMS feedlot study, 92.3 percent of all feedlot cattle are implanted at least one time during the finishing phase.

Two recent Oklahoma studies surveyed 729 producers who received the Beef Cattle Manual (Johnson, 2008 and Vestal et al., 2007). Thirty-seven percent of cow-calf producers with larger operations (more than 100 cows) indicated they implanted their steer calves, while only 9 percent of cow-calf producers with smaller operations (fewer than 100 cows) implanted their steer calves (Vestal et al., 2007). Approximately 60 percent of stocker producers implant their cattle (Johnson, 2008). In fact, 58.6 percent of cattle from designated stocker-only operations nearly always implanted their steers, while only 28.8 percent of steers from stocker operations that included a cow-calf component were implanted. Data from the 2008 National Stocker Survey showed that 78.6 percent of stocker operations with more than 1,000 head implant their cattle, dropping to 52.7 percent in operations with less than 200 stockers.

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

Types of Implants

The compounds used in implants fall into two basic categories. Estrogenic compounds mimic the effects of the naturally occurring hormone estrogen. Estradiol benzoate, estradiol 17-beta and zeranol are each estrogenic compounds. Alternatively, androgenic compounds mimic the effects of the naturally occurring hormone testosterone. Testosterone propionate and trenbalone acetate (TBA) are the principal androgenic compounds used in implants. Synthetic progesterone is also used in implants; however, its effect on the animal is less pronounced than the other two types of compounds. Table 1 has a listing of compound combinations and dosages supplied in commercially available implant products.

All implants are designed to release the compounds slowly through time into the bloodstream of the animal. Different implants are formulated to provide different lengths of time for all of the compounds to be released. This effective period or lifespan of the implant is commonly referred to as the "payout" period. Label claims of payout range from 60 days to 400 days. Factors that affect payout include formulation of the implant, proper administration of the implant, and blood flow to the ear.

Effect of Implants on Beef Cattle Performance

Nursing Calves

Implant products are available for calves weighing less than 400 pounds. Implants cleared for use in nursing calves contain a lower dose of the active ingredient compared to products cleared for use in older cattle. These implants are typically administered when the calves are between two months and four months of age. Research has shown that implants given during the suckling phase will increase average daily gain (ADG) of steer calves by approximately 0.10 pound per day. Response in heifers is slightly lower. Zeranol and estradiol benzoate/progesterone implants appear to produce a slightly better response than estradiol 17-beta products.

Most calf implants are designed for payout in approximately 100 days to 120 days. In some circumstances, the suckling period is long enough that reimplanting would be appropriate. Steer calves implanted twice with zeranol or estradiol

Table 1. Implants available for Stocker Calves.

Approved Uses						*Company*			*Anobolic Compound*		
Suckling Calves <400lbs		*Stockers >400 lbs*		*Feedlot Confinement*							
Steer	*Heifer*	*Steer*	*Heifer*	*Steer*	*Heifer*	*Elanco®*	*Merck®*	*Zoetis®*	*Estrogenic (mg)*	*Andogenic (mg)*	*Payout (Days)*
X	X					Component® E-C			7.2	0.0	120
		X		X		Component® E-S			14.4	0.0	120
			X		X	Component® E-H			14.4	200 Testosterone	120
		X	X			Component® TE-G			8.0	40 TBA	120
X		X		X	X	Encore®			43.9	0.0	336
X		X		X	X	Compudose®			25.7	0.0	168
					X	Component® T-H			0	200 TBA	105
				X	X	Component® TE200			20	200 TBA	120
				X		Component® TE-S			24	120 TBA	120
				X		Component® TE-IS			16	80 TBA	120
				X		Component® T-S			0	140 TBA	105
X	X	X	X	X	X		Ralgro®		36 Zeranol	0	90
				X			Ralgro® Magnum		72 Zeranol	0	90
					X		Finaplix® H		0	200 TBA	105
					X		Revalor® H		14	140 TBA	120
				X			Revalor® IH		8	80 TBA	120
		X	X				Revalor® G		8	40 TBA	120
				X			Revalor® S		24	120 TBA	120
				X			Revalor® IS		16	80 TBA	120
				X	X		Revalor® 200		20	200 TBA	120
				X			Revalor® XS		40	200 TBA	240
X	X			X				Synovex® C	7.2	0	120
			X		X			Synovex® H	14.4	200 Testosterone	120
	X		X					Synovex® S	14.4	0	120
				X				Synovex® Choice	10	100 TBA	12
				X	X			Synovex® Plus	20	200 TBA	120

benzoate/progesterone implants gained approximately 0.12 pounds per day more than nonimplanted control animals. The additional implant did not appear to have as much effect as the initial implant.

Calves should be 30 days to 45 days old before they are implanted. Bull calves intended for breeding should not be implanted. Bull calves not intended for breeding should be castrated at the time of implanting, as one effect of the implant is possible inhibited scrotal development, which makes later castration more difficult.

Stocker Calves

Calves that are weaned and placed on grass or small grain pastures for a period of time before finishing in a feedlot are referred to as stocker calves. There are several implants available for stocker calves (Table 1). Implant research trials have shown an improvement in the ADG of stocker cattle from 8 percent to 20 percent. Numerous trials indicate that producers can expect a 10 percent to 15 percent (0.18 pounds per day to 0.27 pounds per day) improvement in ADG over nonimplanted controls. These studies were conducted through various lengths of time, but the average was approximately 150 days, which is a typical stocker grazing period. Research results are inconclusive concerning the value of one type of compound over the others.

Payout for stocker implants is generally in the range of 80 to 100 days, although several products are available with much longer payout periods. Reimplanting stockers should be considered when grazing periods are longer than 120 days, the implant label indicates a payout period of less than 120 days, and expected ADG during the second phase of the grazing period is moderate or high. Reimplanting in these situations has produced 4 percent to 6 percent improvement in ADG over a single implant. Alternatively, implants designed for a longer payout time may be used as the initial and only implant to provide an active implant through a long grazing season. This would eliminate the need to gather and process the animals at the midpoint of the grazing season.

Factors affecting stocker response to implants are numerous and include sex, weight, genetic gain potential, forage availability, diet quality, supplementation and environmental conditions. Research has shown that as ADG of nonimplanted controls increases (due to pasture quality or other factors), the response to an implant also increases. No adverse effects have been documented from implanting cattle that gain at very low rates. Research has indicated that responses to implants, supplementation and ionophores are 100 percent additive in stocker cattle, and there may be a slight synergistic relationship. Full benefit should be expected from both the implant and the supplement program if both are used in stocker cattle.

Feedlot Cattle

Implants are used extensively by the feeding industry in the U.S. to improve ADG and feed efficiency. The finishing period can range from 120 days to 240 days. A single implant may improve ADG by 0.35 pound per day in steers and 0.25 pound per day in heifers. Feed conversion may be improved by 0.5 pound of feed per pound of gain. Aggressive (high anabolic concentration) feedlot implant programs can result in up to a 21 percent improvement in daily gain and an improvement in feed conversion up to 11 percent. This increased efficiency and weight gain produces a significant economic return. An implant program for finishing cattle must evaluate numerous factors, including decisions concerning timing of implant, ingredient of implant and number of implant times.

Implants can have pronounced effects upon carcass characteristics of cattle. In general, when cattle are fed the same number of days, implants improve carcass weight and ribeye area, while decreasing marbling scores. With these circumstances, implants may reduce the percentage of cattle grading at least USDA Choice by 2 percent to 24 percent. Implants may also slightly increase skeletal maturity, which also impacts USDA Quality Grade. Type of implant, gender and genotype of the animal all influence these responses. However, if cattle are harvested at constant back fat thickness, implants may have little to no impact on quality grade. For a complete review of feedlot implant effects, see Duckett et al., 1997.

Nursing Bull Calves versus Nursing Steer Calves

Many producers follow the practice of leaving bull calves intact until weaning rather than castrating them. The idea is that natural hormones produced in the testicles increase ADG and weaning weight of the calves. Numerous research trials have shown that implanted steer calves gain at a rate equal to, or greater than, bull calves. Castrating bulls as small calves, as opposed to when they are older, reduces overall stress on the calf. The stress and hormonal effects of castration at weaning can reduce post-weaning gain potential and the calf's ability to withstand diseases typically associated with weaning and marketing. This difference in post-weaning performance of bulls versus steers is recognized by cattle buyers, as indicated by the fact that steers will command a $5 to $10 per cwt premium over intact bull calves. Producers wanting to maximize the value of male calves at weaning should consider early castration at birth or at two months to four months of age and use an implant approved for nursing calves.

Lifetime Implanting Strategies

In the modern beef industry, it is fairly common for cattle to receive three or more implants during their lifetime. For producers who operate in only one segment of the industry, the implant decision is simple. However, for producers who retain ownership of an animal through two or more phases and market cattle on a carcass merit price grid, implant decisions become more complex. It is possible that implants administered in one phase can have carryover effects in subsequent phases, however in many studies, this carryover effect has not materialized (Reuter and Beck, 2013). Implants approved for suckling calves are less potent than those approved for stockers, which are less potent than many feedlot implants. A strategy to maximize lifetime gain of the animal while minimizing deleterious effects on carcass quality and animal behavior is an implant program using increasingly potent implants. During the suckling phase, a low potency implant will be used, followed by one or two moderate implants in the growing phase, followed by a moderate implant upon placement in the feed yard, and then a high potency implant 80 days to 100 days before slaughter. The effects of multiple implants on marbling scores may become more dramatic as three or more implants are used during the animal's lifetime. Producers who retain ownership of animals through more than

one production phase should evaluate their overall implant program for the way they are marketing their cattle. Factors to consider are the feed cost, the base value of additional carcass weight, the Choice-Select spread and the potential value of marketing cattle into specialty, non-hormone treated cattle (NHTC) programs.

Implanting Replacement Heifers

Producers often raise the question, "Is it safe to implant replacement heifers?" Research has shown heifer calves intended for use as breeding animals can be implanted one time between 45 days of age and weaning with no significant effect on subsequent conception rates or calving difficulty. Heifers implanted immediately at birth, following weaning or multiple times prior to weaning had significantly lower conception rates compared to heifers receiving a single implant prior to weaning.

Most producers should be able to identify potential replacements heifers at weaning. The producer can then implant the stocker heifers to improve gain and not implant the heifers intended for breeding. See Chapter 29 for a more thorough discussion of implanting replacement heifers.

Economics

Implants are one of the most cost-effective technologies available to cattle producers. Stocker implants typically return of more than $15 for every $1 invested. Implants effectively increase growth rate, increase protein deposition and improve feed efficiency resulting in approximately a 7 percent overall reduction in the cost to produce beef (Lawrence and Ibarburu.). A nursing calf, implanted at three months of age and 150 days before weaning can be expected to have an increase of value from $15 to $30.

Beef Quality Assurance

Implant Location

The only approved implantation site for all brands of implants is subcutaneously in the middle one-third of the back of the ear. The implant must not be closer to the head than the edge of the auricular cartilage ring farthest from the head. The procedure to insert the implant should be done under conditions as sanitary as possible. Cleaning the ear, keeping equipment clean, and using a sharp needle are all recommended. Problems with ear abscesses are the most common cause of implant defects and are usually related to poor sanitation while implanting. Proper animal restraint makes the implanting placement more accurate and the procedure safer for the handlers. Follow all manufacturers' recommendations for implant administration.

Figure 1 shows the correct location. The Food and Drug Administration (FDA) no longer allows implants to be placed at the base of the ear.

Implanting Procedure

A qualified and trained individual should be assigned the task of implanting. Employing the following steps will greatly diminish the incidence of implanting errors, such as abscesses, crushed pellets or missing implants. Achieving an active, undamaged uncontaminated implant in each calf is the goal. Speed will come with practice; it is better to do it right the first time than to have to go back and fix mistakes. Similarly, it is much better to take time and do it right than to pay for an implant and not realize a $20 to $30 per head advantage because the job was not done correctly.

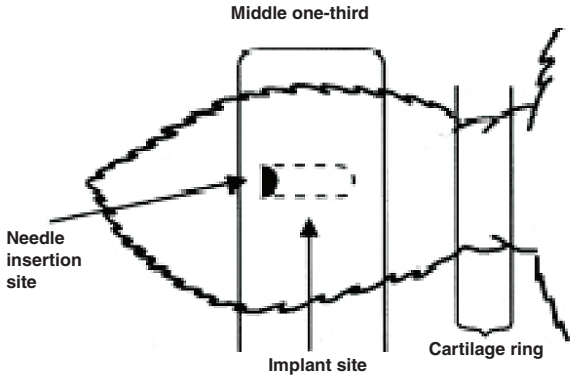

Figure 1. The correct location for implants.

1. Read the label for all animal health products. Ensure the correct dosage, location and procedures are followed. Ensure the product is labeled for use in the class of animal to which it is being administered. Any deviation from label directions carries the potential for stiff legal penalties and should be directed by a licensed veterinarian (Figure 2).
2. Obtain all of the necessary equipment to maintain sanitation. A tray and large sponge soaked in a disinfectant should be used to store the implant applicator between uses. An extra needle for the applicator should be available in case the needle becomes dull, burred, bent or broken. A clean table out of the way of flying debris should be used to store the applicator and implants between uses (Figure 2).

Figure 2.

3. Become familiar with the operation of the implant applicator.
4. Properly restrain the animal to prevent movement. If necessary, further restrain the head by use of a halter (Figure 3).
5. Inspect the animal's ear. Check for previous implants or abscesses, presence of ear tags or ear tag holes, mud, manure or other debris. Clean and dry the implant area by scraping with a knife blade or by wiping with a paper towel and disinfectant (Figure 4). Do not attempt to implant through mud or manure. If an implant is present do not reimplant.

Figure 3.

6. If necessary, wipe off hands before handling the applicator. Mud, manure and blood can contaminate the inner workings of the applicator.
7. Wipe the needle through the sponge to disinfect it. Pull the tip of the needle across the sponge with the bevel facing down against the

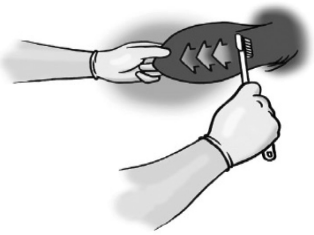

Figure 4.

sponge to clean out any material inside the needle (Figure 5).

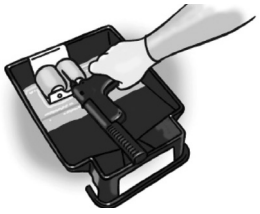

Figure 5.

8. Pinch the tip of the animal's ear between the thumb and index finger of the left hand (for the left ear). Place the tip of the applicator needle against the ear at a slight angle, bevel side up or away from the ear, at the outer edge of the implant zone (Figure 6).

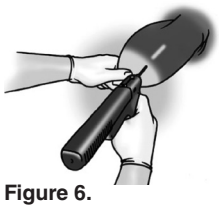

Figure 6.

9. Slide the needle under the skin of the ear and insert it fully. Make sure it is under the skin and not in the cartilage or punctured all the way through the ear. If the needle skips off the back of the ear, return to step number 7. Mud or other debris likely will have gotten caught in the needle bevel, and if not cleaned will be implanted into the ear with the implant on the next attempt. Using sharp needles and slowing down can reduce skipping off.
10. Slide the needle back out of the ear about as far as the length of the implant. Some models of implant applicators have needles that automatically withdrawal the needle.
11. Pull the trigger to deposit the implant and withdraw the needle completely.
12. Feel the implant site to ensure the pellets were correctly deposited, not bunched up or crushed(Figure 7). If so, check equipment, properly restrain the animal and slow down.

Figure 7.

13. Return the applicator to the tray and wipe across the sponge to disinfect it.

Other Issues

- Implants have no slaughter withdrawal, as the ear is always removed as offal during the slaughter process.
- No implants are cleared for use in classes of cattle besides calves, stockers and feedlot animals. This includes breeding animals, cull cows, dairy cattle and veal calves.
- Implants should not be administered at birth due to hormonal development of the calf. Label instructions specify a minimum of 30 days or 45 days of age for administration of calf implants, depending on the implant.
- Implants should be stored properly to maintain effectiveness. Store in a clean dry place in a plastic bag sealed to keep out moisture and debris. Consult the label for storage temperature.
- If possible, implant cattle on dry days when the cattle are dry and free of mud. This will reduce the incidence of abscesses.
- One implant manufacturer offers a line of implant products that include both the anabolic compound pellet and a pellet containing a dose of the antibiotic TylanTM. The purpose of the antibiotic pellet is to dissolve soon after administration and reduce the incidence of implant site abscesses.

Safety of Implants

Animal Health

Implants are suspected to directly cause, or be associated with, several undesirable changes in animals. Responses normally associated with reproductive processes are observed in heifers, including signs of estrus, vaginal or rectal prolapses, development of the udder and other problems. Implants may increase the incidence of bullers in steers. Bullers are steers that will stand to be mounted similar to the behavior of a cow in estrus. However, it is thought that bulling is caused by a physiological defect in the animal and implants merely exacerbate this condition. Estimates of the frequency of the occurrence of bullers range from 1 percent to 4 percent.

Food Safety

Table 2 reports the estrogenic activity of foods commonly consumed in the U.S. Beef from steers and heifers fed for slaughter have a very low level of estrogenic activity, regardless of implant status. In fact, ice cream contains 553 times more estrogen than beef. The safety of implants is assured when FDA approved products are used according to their labels. History and several organizations including, but not limited to, the U.S. FDA, the World Health Organization and the Food and Agriculture Organization have concluded that the use of implants in beef production poses no safety risk to consumers.

Table 2. Estrogenic activity of several common foods.

Food Estrogenic	*Activity*[a]
Soybean oil	1,000,000
Cabbage	12,000
Wheat germ	2,000
Peas	2,000
Eggs	17,500
Ice cream	3,000
Milk	65
Beef from pregnant cow	700
Beef from implanted cattle	11
Beef from nonimplanted cattle	8

[a] Nanograms of estrogen per 500 grams of food.
Source: Preston.

References

Johnson, R. (2008) Adoption of Recommended Management Practices in Stocker Cattle Production. M.S. Thesis. Oklahoma State University.

Kuhl, G.L. (1997) Stocker Cattle Responses to Implants. Proceedings: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma State University, P-957. Pg 51.

Lawrence, John D and Maro A. Ibarburu. Iowa State University. http://econ2.econ.iastate.edu/faculty/lawrence/documents/GET7401-LawrencePaper.pdf

Mader, T. (1997) Carryover and Lifetime Effects of Growth Promoting Implants. Proceedings: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma State University, P-957. Pg 88.

Paisley, S.I. et al. (1997) Effect of Implants on Performance of Steers Dry-Wintered on Native Tallgrass Prairie. Animal Science Research Report, Oklahoma State University.

Preston, R. (1997) Rationale for the Safety of Implants. Proceedings: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma State University, P-957. Pg 199.

Reuter, R. R. and P. A. Beck (2013). Southern Section Interdisciplinary Beef Symposium: Carryover effects of stocker cattle systems on feedlot performance and carcass characteristics. *Journal of Animal Science*. Vol 91, Pg. 508.

Selk, G. (1997) Implants for Suckling Steer and Heifer Calves and Potential Replacement Heifers. Proceedings: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma State University, P-957. Pg 40.

USDA-NAHMS. *Trends in Health and Management Practices on U.S. Feedlots,* 1994-2011 (July 2013) National Animal Health Monitoring System, United States Department of Agriculture.

Vestal, M. et. al. (2007) Cow-calf Production Practices in Oklahoma – Part I. OSU Extension Fact Sheet AGEC-245, Oklahoma Cooperative Extension Service, Oklahoma State University.

Wettemann, R.P. and F. Lehman (1997) Buller Steers – Causes and Control. Proceedings: Impact of Implants on Performance and Carcass Value of Beef Cattle. Oklahoma State University, P-957. Pg 123.

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, Director of Oklahoma Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 000 cents per copy.

ANSI-3290-7