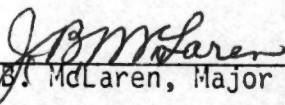


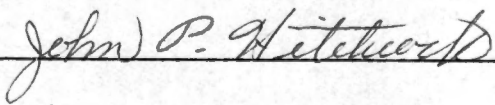
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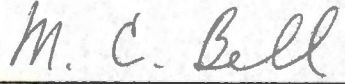
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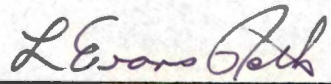
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EFFECTS OF RALGRO[®] ON PERFORMANCE OF MARKET-TRANSIT
STRESSED FEEDER STEERS

A Thesis

Presented for the
Master of Science

Degree

The University of Tennessee, Knoxville

William Ray Abner, Jr.

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CHAPTER I

INTRODUCTION

Cow-calf producers of Tennessee and other southeastern states market their calves as feeders which will be finished in western or corn-belt feedlots. These feeder calves are generally weaned as they are transported to the auction barn and are further stressed throughout the market-transit system as they move from the farm where they were raised to the feedlot. Thus, these feeder calves are very susceptible to the bovine shipping fever complex. Etiology of shipping fever has been suggested by various investigators (Hoerlein and Marsh, 1957; Nichols, 1962; Hamdy et al., 1964).

Since the specific causes of shipping fever are not fully understood or identified, it is difficult for preventive measures to be justly recommended and successfully practiced. But numerous preshipment practices have been recommended (Herrick, 1969; Hoerlein, 1973; Greathouse et al., 1973; Norman, 1974; Koers et al., 1974). The potential for the growth promotant Ralgro[®] to aid in the reduction of market-transit weight losses and thus be included in preshipment practices to reduce these losses has not been intensely studied. However, previous studies have yielded information that may suggest a possible advantage of implanted calves over non-implanted calves with respect to resistance to market-transit stress and recovery from market-transit weight losses during the early feedlot period (Brown et al., 1976; Smith et al., 1976; Rieson et al., 1977). The objectives of the present study were:

1. To determine the influence of preshipment rate of gain on the effectiveness of Ralgro[®] implantation as a growth promotant in feeder steers.

2. To determine the effectiveness of Ralgro[®] implantation on decreasing body weight shrink of feeder steers due to market-transit stress.

3. To determine the effectiveness of Ralgro[®] for improving feedlot performance of feeder steers.

CHAPTER II

LITERATURE REVIEW

Zeranol, the active component of Ralgro[®], is produced by chemical synthesis from zearalenone, a pure crystalline metabolite of the fungus Giberella zeae. Zeranol belongs to a group of naturally occurring products known as the resorcylic acid lactones (RAL). Stob et al. (1962) discovered these compounds during 1957 and 1958 while feeding moldy corn to pigs. Upon experimentation, uterotrophic activity was found in castrated female mice and anabolic activity was observed in sheep fed the moldy corn. Urry et al. (1966) proved the chemical identity of zeranol as B-resorcylate.

Effects of Age and Sex on the Growth Promoting Ability of Zeranol.

The growth promoting properties of zeranol have been studied in an attempt to identify possible interactions between zeranol and other influences, such as sex and age of the animals and feeding regimes. Hafs et al. (1971) cites that growth response to estrogen administration tends to be more variable in young than in mature animals. In two of three years of research, Ralston (1978) reported that newborn calves implanted with 24 mg of zeranol had higher weaning weights when compared to non-implanted calves. Contradicting results concerning the benefit of zeranol to offset the expected weight loss due to castration were cited.

In field studies involving zeranol, Corah (1979) reported that during a 152-day trial suckling calves implanted once with 36 mg of Ralgro[®] gained an average of 22.1 lb more than the non-implanted controls. Two

36 mg implants, one at 1.5 months of age and the other 70 days later resulted in a 54.1 lb increase in gain at weaning over controls. Corah (1979) reported another trial in which calves implanted at birth, at 4 months of age, and at birth and reimplanted at 4 months of age were compared to non-implanted controls. Implanting at birth gave an equal response to implanting at 4 months of age (27.9 and 28.4 lb over the controls, respectively). The calves implanted twice gained 46.6 lb more than the non-implanted calves.

Perry et al. (1970) found no consistent benefit in weight increases which could be attributed to zeranol implants when calves were fed to limit gain at approximately .6 kg/day. When growing heifer calves were fed an intake level which limited gain to .45 kg/day, zeranol implantation increased gain 20%. The effect of zeranol was greatest during the early stages of the trial, but by day 154 the effect had greatly diminished. Sewel (1978) reported a 10 lb/calf increase in weaning weight of suckling steer calves implanted with 36 mg of zeranol over non-implanted steers and a 14 lb/calf increase for heifer calves. The response to Ralgro[®] in the heifer calves was greater and more consistent than in steer calves. In work by Sharp and Dyer (1971), yearly heifers implanted with 36 mg zeranol increased average daily gains (ADG) 1.4% over that of the controls and implantations of 72 mg increased ADG 9.5% over that of the 36 mg treatment and 25% over that of the non-implanted controls.

Brethour (1979) reported that steers implanted with zeranol at the beginning of the growing phase and reimplanted at the beginning of the finishing phase 163 days later gained 19.9% more than non-implanted calves. Brethour recommended that Ralgro[®] implants should not be a

substitute for good nutrition and facilities, but should supplement these practices if maximal response to implants are expected. Borger et al. (1973) reported that during a 169-day trial cattle implanted with zeranol gained 7.8% faster than the controls.

According to Perry et al. (1970), a 13% improvement in gain during the first 56 days after implantation resulted when yearly steers were implanted with zeranol, and gains in older and heavier steers were improved by 9% during the same time period. There were no differences in gain of implanted heavy or yearling steers over their respective non-implanted control by the end of the 156-day trial. A second implant of 36 mg of zeranol to the steers on feedlot day 56 resulted in an additional 8% increase in gain over animals implanted once on feedlot day 1.

Wilson et al. (1972) found that for sheep treated with zeranol, post weaning ADG was increased by 10.6% in all sexes. Implantation was most effective for wethers, least effective for ewes, and rams and cryptorchids were immediate. The improvement in ADG in the four sex groups was 12.5%, 7.9%, 10.9%, and 9.8%, respectively. Wangsness et al. (1981) found that the rate of gain was significantly greater for lambs implanted with 12 mg of zeranol than in non-implanted control lambs.

Effects of Diet on the Growth Promoting Potential of Zeranol

The effect of different feeding regimes on zeranol efficiency has been studied. Sharp and Dyer (1971) reported that 72 mg zeranol implants improved feed efficiency by 13.2% for heifers fed a 70:30 (concentrate: roughage) diet. Feed efficiency decreased by 4.8% following 72 mg zeranol implants in heifers fed an 80:20 ration and it decreased 10.7% for heifers fed 60:40 ration. Implants of 36 mg and 72 mg increased the

rate of gain for heifers by 19% and 24%, respectively, over the controls. In steers fed either wheat, barley, corn or milo, Sharp and Dyer (1971) observed that 36 mg implants increased gains by 25.9%, 19.4%, 14.3%, and 4.9%, respectively. They also observed that the response to zeranol was greatest during the first 28 days of the trial regardless of diet. For steers fed 12% or 18% protein rations, the improvement in gain due to zeranol implants was 13%. Lambs implanted with 12 mg zeranol had a 16% increase in rate of gain. Feed efficiency was improved by 16.6%. Nicholson et al. (1974) reported that the positive response of zeranol occurred regardless of dietary energy level.

Bennett et al. (1974) reported improvements of 10-14% in growth rate and feed conversion for cattle implanted with 36 mg zeranol over controls and a 9% improvement in cattle implanted twice with 36 mg. The implanted cattle attained the designated slaughter weight (400 kg) 31 days earlier than the controls. In other trials by Bennett et al. (1974), it was reported that implanted cattle had 7.7 to 12.0% higher ADG than the controls. For cattle taken off grass for confinement finishing, the implanted cattle exhibited 20.7 to 24.0% improvement of weight gains over controls. In cattle on grass, weight gains of the implanted cattle averaged 35% greater than controls after 65 days. Many reports have shown that zeranol implantation did not significantly change feed consumption (Sharp and Dyer, 1970; Thomas and Arritage, 1970; Borger et al., 1973a; Hathoway et al., 1973; Wiggins et al., 1976; Wiggins et al., 1979).

Effects of Zeranol on Carcass Characteristics

Wiggins et al. (1979) reported that zeranol increased final weights of lambs fed for a constant time but observed no significant difference

in carcass weights of the implanted and non-implanted lambs. The implanted lambs had heavier gastrointestinal tracts and thus lower dressing percents than the controls. Wilson et al. (1972) reported that zeranol had no effect on dressing percent of rams, cryptorchids, wethers, and ewes. Zeranol did not significantly affect fat thickness, longissimus area, percent kidney and knob fat, cutability, or marbling score and, therefore, they concluded that zeranol does not measurably alter carcass composition.

Sharp and Dyer (1970) observed an increased percentage of body water and protein and a decreased percentage of body fat in implanted steers. Perry et al. (1970) observed no significant effects of zeranol on carcass grade in beef cattle.

Sharp and Dyer (1971) reported that the increase in body weight gains of lambs and steers implanted with 12 and 36 mg of zeranol, respectively, consisted of water and protein. They also suggested that the protein content of the whole body was increased at the expense of fat in zeranol implanted animals. Nitrogen retention in lambs was significantly increased by zeranol but due to decreases in fat deposition the retention of energy was decreased.

Physiological Consequences

Many research studies indicate that insulin, prolactin (PRL), growth hormone (GH), adrenocorticotrophic hormone (ACTH) and corticosteroids all increase in zeranol treated animals. Olsen et al. (1977) reported that wether lambs implanted with 12 mg zeranol had increased serum GH and insulin, but serum urea nitrogen and glucose were unchanged. With zeranol infusions, serum GH and insulin were not increased, indicating that chronic exposure to zeranol was necessary to stimulate the response. In other

studies, Wangsness et al. (1981) reported higher serum insulin concentrations ($P < .05$) in lambs implanted with 12 mg zeranol over controls.

Trenkle (1970) reported the average insulin concentration in plasma of steers to be 32.1 $\mu\text{U/ml}$ and 27.9 $\mu\text{U/ml}$ for two groups of steers on a finishing ration. One group of the steers then received 10 mg stilbestrol/day. The insulin levels for the groups of steers then were 39.9 $\mu\text{U/ml}$ for controls and 43.9 $\mu\text{U/ml}$ for the steers fed the finishing ration plus stilbestrol. GH concentrations were 21.0 $\text{m}\mu\text{g/ml}$ for the control steers and 38.6 $\text{m}\mu\text{g/ml}$ for the steers fed the finishing ration plus stilbestrol. Wagner et al. (1970) reported that non-specific stress had no effect on plasma GH levels in wether lambs.

Borger et al. (1973b) reported that steers implanted with zeranol had significantly greater serum GH levels, and this is in agreement with Trenkle (1970) who cited that the growth stimulant diethylstilbestrol (DES) increases serum GH levels in finishing steers. Rothenbacher et al. (1975) reported increased reaction and activity of the target organs (urogenital tract, mammary, adrenal, hypophyseal, and thyroid glands) as doses of zeranol implants increased from 0 to 96 mg in wethers. The adrenal gland weight and the adrenal/thyroid gland ratio also increased. Mammary gland development became noticeable in null-parus animals at a zeranol level of 24 mg and increased thereafter to progressive alveolar growth and secretory activity with 48 and 96 mg doses. Early work with zeranol revealed that it had only about 1/2,500 the uterotrophic activity of DES (Perry et al., 1970).

Sharp and Dyer (1970) reported increased performance in steers implanted with 36 mg zeranol and these steers had significantly higher

concentrations of plasma insulin. It was suggested that the increased growth was due to increased protein anabolism, increased water retention, and decreased fat synthesis. Slight increases in feed intake by these steers could not account for the increased performance.

Wiggins et al. (1979) reported a significant sire breed X implant interaction with respect to increased pituitary gland weights of implanted lambs. The increased pituitary gland weight may reflect increased gland activity since zeranol increases circulating GH levels. Serum thyroxine levels were lower for zeranol treated lambs. Rothenbacher et al. (1975) reported that after thyroid gland weights of implanted wethers decreased, secretory activity of thyroid epithelial cells decreased. Changes in eosinophilic cells and basophils were consistent with increased somatotropin and adrenocorticotropin secretion and decreased thyrotropin secretion.

Wiggins et al. (1976) reported that zeranol increased ram blood GH levels to a greater extent than DES and decreased blood urea nitrogen (BUN) levels in rams and wethers more so than DES, while DES exhibited a greater depressing effect on blood lutenizing hormone (LH) level than zeranol. Zeranol also decreased blood insulin and increased cortisol levels. Adrenal and thyroid gland weights increased with zeranol implantation, contradicting reports by Borger et al. (1971a) that no increase in thyroid gland weights occurred of implanted steers. Nocenti (1968) states that it is conceivable that DES and zeranol could increase adrenocortical steroid production either by increased ACTH release or direct action of estrogens on the adrenal cortex.

Possible Modes of Action

Beverly (1979) explained the endocrinology related to growth. Growth hormone has a general action on total body growth and stimulates muscle and bone development. A combined endocrine effect of estrogen + progesterone + prolactin (PRL) + GH + ACTH stimulates lobulo-alveolar mammary growth and could partially explain why zeranol or other anabolic agents stimulate teat development in sheep and cattle as suggested by Rothenbacker et al. (1975) and Perry et al. (1970). Zeranol may be competing for estrogen receptor sites along with increased secretion of PRL, GH, ACTH, and corticosteroids. Beverly (1979) summarizes the effects of GH as follows:

1. Growth of long bones and increase in width of the epiphyseal cartilage.
2. Increased amino acid uptake by muscle tissue.
3. Increased mobilization of fatty acids for protein synthesis.
4. Increased mobilization of fatty acids and glycerol from adipose tissue for metabolism by other tissues.
5. High concentrations of GH decreases the oxidation of glucose which results in increased blood glucose and secretion of insulin.

Many factors such as stress and extreme starvation increase the secretion of GH in some species. This stimulation of GH secretion has been observed more frequently in nonruminants than in ruminants. Hertelendy et al. (1968) reported consistent increases of 5 to 10 fold in plasma GH of lambs receiving infusions of epinephrine. Davis (1971) demonstrated that amino acid infusion will increase plasma GH and insulin. Different effects of diet on GH have suggested that GH is involved in mobilization

of nutrients during times of increased stress. Because of the increased release of fatty acid from glycerol from adipose tissue, increased uptake of amino acids and increased protein synthesis in skeletal muscle, animals with greater secretion of GH have more muscle and less body lipids. Stressful stimuli increase ACTH secretion and in turn the increased ACTH increases glucocorticoid release and results in metabolic consequences such as decreased protein synthesis and reduced glucose oxidation. Increased levels of glucocorticoids are involved in adaptation to stress and have prolonged effects on the animal.

Heitman (1979) presents useful insight on the mechanism in the action of anabolic agents as growth promotants for farm animals. He concluded that the differing modes of action of androgens and estrogens in the regulation of protein metabolism support the hypothesis that to obtain maximum growth the best steroid treatment would maintain physiological concentrations of both androgens and estrogens in the circulating body fluids. Wangsness (1979) explained possible modes of action of zeranol. Studies on the mode of action are much less consistent than animal performance studies. The hormones insulin, GH, glucocorticoids, and thyroxine have been shown to have influences at the cellular level on muscle protein formation. After zeranol implantation, serum glucose is unchanged and BUN is unchanged. Some studies show a lowering of BUN. Decreased BUN is consistent with the more efficient use of dietary protein nitrogen and may be indicative of increased muscle growth.

Studies have illustrated that zeranol implantation increases pituitary gland weight (Rothenbacher et al., 1975; Wiggins et al., 1976; Wiggins et al., 1979), increased thyroid gland weight (Wiggins et al.,

1976), increased adrenal gland weights and ACTH secretory cell numbers (Rothenbacher et al., 1975; Wiggins et al., 1976), increased GH concentrations (Borger et al., 1973; Rothenbacher et al., 1975) and increased insulin concentrations (Sharp and Dyer, 1970; Olsen et al., 1977; Wangsness et al., 1981). It has been suggested that zeranol implanted animals may react less severely to stress because of changes in various hormones including cortisol, lutenizing hormone (LH) (Rieson, 1977) and thyroxine.

Estrogen may influence body growth through action on the pancreas and thus its hormones. Hafs et al. (1971) explained a possible mechanism for increased growth. Melengestrol acetate (MGA) may do so via increased estrogen production by the ovaries because MGA only stimulates growth in heifers, not in steers or castrate heifers. Correlations between measures of GH status in bulls and slaughter weights after time constant feeding periods or specific growth rates (percent of slaughter weights acquired during the preceding month) revealed that none of the measures of GH status were closely related to measures of body growth and, in fact, some were significantly negative. Thus no evidence was found to illustrate that plasma levels of androgen or GH limited growth rate in these bulls. Zeranol has been shown to be most effective in slower growing animals (Henson, 1970; Sharp and Dyer, 1971; Wilson et al., 1972; Jackson et al., 1974).

The anabolic effects of estrogens have been attributed to increased GH and insulin levels (Trenkle, 1969; Trenkle, 1976) and these two hormones could logically explain the anabolic action of zeranol, even though zeranol has negligible estrogenic activity and is not considered an estrogenic compound (Peck, 1977), but as Preston (1975) explains, the

definition of estrogenic activity can be quite ambiguous. Wangsness (1979) reported in vivo release of GH from pituitary cells into culture media due to zeranol, and this may support the reported in vivo studies which have consistently shown increased GH levels for implanted animals. The actions of GH on stimulating cell division time, growth, including increased DNA and RNA synthesis, as well as the effects on energy metabolism are well known. The net results are a positive nitrogen balance, body weight gain, and increased skeletal growth.

Much of the anabolic activity of GH is now thought to be mediated by somatostatin (Chocinov and Daughaday, 1976). Somatostatin is a powerful inhibitor of GH and is released from the hypothalamus, small intestine, stomach, and pancreatic tissue. It also inhibits insulin and glucagon. Whether increased GH after zeranol implantation has a primary effect by acting directly at the tissue level is in question. Various types of experimental evidence support the theory that GH acts via a group of serum factors--somatomedins. The identified somatomedins are peptides with broad anabolic actions on body tissue. They have insulin-like actions such as in cartilage stimulation of sulfate uptake, amino acid transport, and synthesis of RNA and DNA. In muscles they stimulate protein synthesis and glucose uptake; in fat they promote glucose oxidation and decreased fat mobilization. This indicates that there is some interaction between somatomedins and insulin. It appears that they are released under regulation of GH and, therefore, are GH dependent (Phillips, 1979). It is conceivable that the anabolic action of zeranol is only mediated by growth hormone and the primary effect may be increased somatomedin concentrations.

Wangsness et al. (1981) studied serum somatomedin like activity in zeranol implanted lambs. Somatomedin like activity and fibroblast proliferative activity (presumed to support cell growth) were not affected by zeranol implantation and therefore it was concluded that these serum factors did not appear to be involved in zeranol-stimulated growth.

Zeranol and other anabolic agents may promote growth by interaction at the cellular receptor site. Reported evidence shows that zeranol results in a change of hormone status of animals which accompanies increased growth and efficiency of feed conversion. Recent information on hormone activity at the site of hormone production and receptor sites of target cells may indicate that zeranol also acts there and its anabolic effect is simply mediated by increased GH and/or insulin concentrations.

Shipping Stress

Feeder cattle undergo many various stresses throughout the market-transit system. Wilson (1971) presented an excellent review on stressor agents and their impact on the animal. The stresses due specifically to the marketing-transit system, and thus perhaps predisposing to the shipping fever complex, are of major concern to producers. Fleming (1975) estimated economic losses due to shipping fever to be one-half billion dollars per year.

Nichols (1962) cited three properties concerning the shipping fever complex. First, there is at least one of many possible infectious agents present. Second, the animal probably has undergone obscure functional changes which predispose the animal to their infectious agents and to the shipping fever complex. Third, the animal undergoes hormonal responses, in particular ACTH and hydrocortisone concentrations increase

and affect metabolism. Hoerlein and Marsh (1957) stated that the development of shipping fever occurs within 45 days after shipment and interactions of stressors, viruses and bacteria are all involved in its epizootology. Other studies pertaining to the etiology have been presented (Heddleston, 1962; Hamdy et al., 1964a).

Hamdy et al. (1964b) attempted to identify the specific infectious agents by attempting to reproduce shipping fever and then produce vaccines for those agents. Hamdy et al. (1965) concluded that these vaccines had no appreciable effects on morbidity.

Preconditioning the calves, or other preshipment practices, prior to transit have been recommended by various researchers (Herrick, 1969; Greathouse et al., 1973; Hoerlein, 1973; Norman, 1974; Koers et al., 1974).

Crookshank et al. (1979) found that calves weaned two weeks prior to the feeding period (EW) gained about five times more than a group of calves not weaned prior to the 16-day feeding period (W) and nine times more than a group of calves trucked for 12 hours then taken to the feeding period (WT). Effects of handling and transporting would have decreased with a longer feeding period, but as Jensen et al. (1976) demonstrated, 72% of the fatal cases of shipping fever developed within the first 45 days on feed. Trucking significantly affected plasma cortisol levels. For the W calves, cortisol dropped slightly for 12 hr, peaked at 1 day and returned to the initial levels at 2 days. For the WT calves, plasma cortisol increased through 24 hours, remained constant for 24 hours and then returned to initial levels by days 4-7. These researchers found that trucking stress is greater than handling stress and calves become accustomed to the handling. This study shows that shipping calves during the first 4-7 days after weaning might be a factor in the shipping fever complex.

CHAPTER III

EXPERIMENTAL PROCEDURE

Much of the research involving stress, starvation, and other aspects of the Shipping Fever Complex has been conducted in the laboratory. Several researchers have suggested that shipping fever research studies should be conducted in the field if these studies are expected to yield results which can be applied to solving the huge industry problem. This would entail monitoring the calves at the farms where they are raised (farm of origin), at the auction barn, at the orderbuyer barn, and during transport from the market to the feedlot. From intensive surveys conducted by various groups concerned with a multi-region shipping fever project, the range and mean values for specific practices used by the feeder-calf marketing industry in the southeastern part of the United States were established. Calves are usually marketed through auction sales at weaning. At the auction barns, calves from one farm are co-mingled with calves from other farms and generally remain at the auction barn for 18-36 hr (mean = 24 hr). At the auction barn, the calves receive no feed or water and are contained in approximately 8 to 12 ft²/calf of pen space. At the auction barns, the calves are purchased by various orderbuyers who transport them to their barns. They remain at the orderbuyer's barn until enough calves of a specific weight and grade are assembled to fill a feedlot order. The length of stay at the orderbuyer barn can, therefore, vary with season as the intensity of cattle marketing fluctuates. On the average, however, calves spend about 72 hr in the orderbuyer barn

where they receive hay and water and are allowed 18 to 30 ft²/calf of pen space.

For the four trials reported herein, steer calves weighing from 275 to 640 lb were purchased from various Tennessee producers. Two trials were conducted during 1979-1980 (trials 1 and 2), and two trials were conducted during 1980-1981 (trials 3 and 4). At the farms of origin, 30 days prior to transport to the auction barn, the calves were randomly assigned to Ralgro[®] treatment groups. The treatment groups were: 1) a non-implanted control group, 2) implanted with 36 mg of zeranol 30 days prior to transport to the auction barn at the farm of origin, and 3) implanted with 36 mg of zeranol 30 days prior to transport to the auction barn at the farm of origin and again upon arrival at the feedlot. During 1979-80, IBR treatments were used in a factorial arrangement with the Ralgro[®] implant levels. These treatments were: 1) injection 30 days prior to transport to the auction barn with a commercial IBR vaccine, 2) injection with IBR vaccine 30 days prior to transport to the auction barn followed by a cell mediated immune booster upon arrival at the auction barn, and 3) a non-vaccinated control group.

At various points along the market-transit system, data were collected on these calves. These data included body weights, rectal temperatures, packed cell volumes and clinical evaluations. The points of data collection were: 1) at the farm of origin 30 days prior to arrival at the auction barn (FO), 2) upon arrival at the auction barn (AAB), 3) 24 hr after AAB which coincides to arrival at the orderbuyer barn (AOBB), 4) departure from the orderbuyer barn (DOBB), 5) upon arrival at the feedlot (AFL), and 6) at various points at the feedlot (FL).

For this study, a commercial auction barn at Algood, Tennessee was provided by the owners. This facility was used for a weekly livestock auction and by several orderbuyers as an intermediate assembly. This provided an opportunity for conducting the study under industry environment. When the calves were assembled at the auction barn they were assigned to pens with approximately 10 ft^2 pen space per calf without access to hay or water for a period of 24 hours. After this auction barn phase, during which the calves were actually exposed to auction ring stress, graded and weighed, they were moved to larger pens where they were allowed more pen space (about $25 \text{ ft}^2/\text{calf}$) and access to hay and water for a 72 hr orderbuyer barn phase.

The calves of trials 1 and 3 were loaded into trucks and transported 830 miles to The Southwestern Livestock and Forage Research Center at El Reno, Oklahoma. Upon arrival at El Reno, all calves were assigned to a receiving diet which was fed ad lib for 28 days. Following this receiving period, all calves were moved to a winter wheat pasture for a 100 day backgrounding period. Supplemental grass hay was also offered free choice. During periods when wheat pasture was not available, the calves were fed a concentrate-hay diet designed to produce gains similar to the expected gains on wheat pasture. The calves were then trucked to The Southwestern Great Plains Research Center at Bushland, Texas for feedlot finishing.

Calves in trials 2 and 4 were transported 300 miles to The University of Tennessee, Highland Rim Experiment Station (HRES), Springfield, Tennessee. Upon arrival at the HRES feedlot, all calves were assigned to pens and were fed two pounds of cracked shell corn per calf per day

and hay free choice for 3 to 4 days. After feedlot day 4, increasing amounts of crushed corn were incorporated into the ration and cottonseed meal was also fed. By feedlot day 20 for trial 2 and feedlot day 6 for trial 4, corn silage was being fed to the calves in increasing amounts. No more hay was fed after feedlot day 12 in trial 4 and feedlot day 21 for trial 2. During the first 140 days in the feedlot, corn silage was fed free choice, crushed corn was fed at 1 to 1.5% of body weight and cottonseed meal was fed at the rate of one pound per calf per day. After about 140 days in the feedlot, the diet was changed to whole shelled corn and a protein supplement designed to be fed with the whole shelled corn.

CHAPTER IV

INFLUENCE OF PRESHIPMENT RATE OF GAIN ON THE EFFECT OF RALGRO[®] IMPLANTATION OF MARKET-TRANSIT STRESSED STEERS

The anabolic agent Ralgro[®] has been extensively studied since its discovery by Stob et al. (1962). Its growth promoting ability has been studied in diverse trials where the subjects ranged from young calves to feedlot cattle. A wide range of results have been reported within each age classification (Perry et al., 1970; Sharp and Dyer, 1971; Borger et al., 1973a; Bennett et al., 1974; Corah, 1979; Wiggins et al., 1979).

Possible modes of action for Ralgro[®] have been presented in the literature. It has also been suggested that Ralgro[®] is more effective as a growth promotant in slower growing animals than in those growing more rapidly (Henson, 1970; Sharp and Dyer, 1971; Wilson et al., 1972; Jackson et al., 1974). These results could probably indicate the maximum potential benefit that could be derived from the practical application of Ralgro[®] implants. In addition, the results could also provide some insight into the mode of action of Ralgro[®].

The objective of this study was to determine the influence of preshipment rate of gain on postshipment feedlot response of newly arrived market-transit stressed feeder calves to Ralgro[®] implants. In these trials weanling steers were classified in a low, intermediate, and high preshipment rate of gain group. Steers within each rate of gain group were allotted to either a non-implanted control group, a group implanted preshipment with 36 mg of Ralgro[®], or a group implanted

preshipment with 36 mg of Ralgro[®] and reimplanted with 36 mg of Ralgro[®] upon arrival at the feedlot.

Procedures

During the fall marketing seasons of 1979 and 1980, 397 steer calves ranging in weight from 275 to 640 lb were purchased from 9 Tennessee cow-calf producers. Approximately 30 days prior to transportation from their farms of origin (F0) to an auction barn, the calves on each farm were weighed and randomly assigned to a treatment group. The treatment groups consisted of 1) a non-implanted control group, 2) a group implanted with 36 mg of Ralgro[®] at F0, and 3) a group implanted with 36 mg of Ralgro[®] at F0 and reimplanted with 36 mg Ralgro[®] upon arrival at the feedlot (AFL).

All calves were transported to the Algood Livestock Auction barn, Algood, Tennessee, on the same day each year. As the calves arrived at the auction barn, they were weighed and subjected to an auction barn environment for 24 hr during which the calves were tightly penned (8 to 12 ft²/calf) without access to hay or water. Following the auction barn phase the calves were subjected to 72 hr of an orderbuyer barn environment in which they were allowed more pen space (18 to 30 ft²/calf) and had access to medium quality, mixed grass hay and water. After the order-buyer barn phase, the calves were trucked to either 1) a feedlot at the Highland Rim Experiment Station (HRES), Springfield, Tennessee, or 2) to the USDA-AR Southwestern Livestock and Forage Research Center, El Reno, Oklahoma where they were backgrounded on wheat pasture for about 140 days prior to being shipped to a feedlot at USDA-AR Southwestern

Great Plains Research Center in Bushland, Texas. Calves shipped to HRES each year (trials 2 and 4), were allotted to the three Ralgro[®] treatments. Calves shipped to El Reno (trials 1 and 3), were allotted to treatments 1 and 2 only.

Calves at the HRES feedlot were fed a receiving diet of hay, free choice, plus a limited amount of cottonseed meal, cracked shelled corn, and corn silage for 7 to 14 days. During the remainder of the 140 day growing phase, the calves were fed a diet of corn silage free choice, 1 lb of cottonseed meal per calf per day, and cracked shelled corn at the rate of 1.50 to 1.75% of their body weight. Following the growing phase, the calves were fed a whole shelled corn-protein supplement diet until they were slaughtered. The calves at El Reno were fed a hay-grain diet designed to simulate gains of calves grazing wheat pasture. The duration of the feeding period differed for each shipment and depended on the year and location. In 1979 the calves at El Reno, trial 1, were fed for 297 days and the calves of HRES, trial 2, were fed for 240 days. In 1980-81 the calves at El Reno, trial 3, were evaluated after 56 days in the feedlot and the calves at HRES, trial 4, were evaluated after 96 days and only data collected prior to these dates are included in this report.

Calves were classified into three groups (RATE) on the basis of the FO average daily gains (ADG). A value for RATE, 1, 2 or 3, was assigned to each calf depending on its ADG during this period. Slow gaining steers were assigned to the rate of gain group 1, fast gaining steers were assigned to the rate of gain group 3, and those intermediate were assigned to the rate of gain group 2. The ranges in ADG used for classification

of calves in the various RATE groups varied across shipments and were chosen such that a similar number of calves would be assigned to each RATE group in each shipment. These ranges of ADG are given in Table 1.

Analysis of variance procedures were used to evaluate the effects of the independent variables (rate of gain and Ralgro[®] implant level) and their interaction on the dependent variables (feedlot performance traits).

Results

Differences in feedlot performance among groups of calves implanted once or twice with 36 mg of Ralgro[®] and the effect of preshipment rate of gain on the response to Ralgro[®] implants are presented in Figures 1 and 2. The overall rate of gain of calves shipped to HRES (trials 2 and 4) was greater than that of calves shipped to El Reno (trials 1 and 3). This difference in postshipment gain was probably due to the differences in postshipment feeding systems. At the HRES feedlot calves were full fed corn silage with limited grain and at El Reno backgrounding on wheat pasture was simulated. McLaren et al. (1971) reported similar postweaning feedlot gain for steers fed corn silage free choice with 5 lb of concentrate per steer per day. Another possible explanation for these differences in gain could be that calves shipped to HRES were purchased from different feeder calf producers than those shipped to El Reno and genetic differences influenced postshipment gains. Differences in rate of gain between 1979 and 1980 at both HRES and El Reno can be explained by differences in the length of trials during the 2 years. Calves at El Reno (trials 1 and 3) were fed for 297 and 56 days in 1979 and 1980,

Table 1. Range in average daily gain^a of calves classified to each preshipment rate of gain group within trials.

Rate of gain group (RATE)	1		2		Trial A		3		4	
	Gain	No.	Gain	No.	Gain	No.	Gain	No.	Gain	No.
1	below 1.20	(44) ^b	below 2.00	(19)	below 1.40	(28)	below 1.10	(18)		
2	1.20 to 2.20	(85)	2.00 to 2.60	(17)	1.40 to 1.85	(33)	1.10 to 1.75	(18)		
3	over 2.20	(58)	over 2.60	(18)	over 1.85	(34)	over 1.75	(18)		

^aPounds per calf per day.

^bNumbers in parentheses are the number of calves in that particular group.

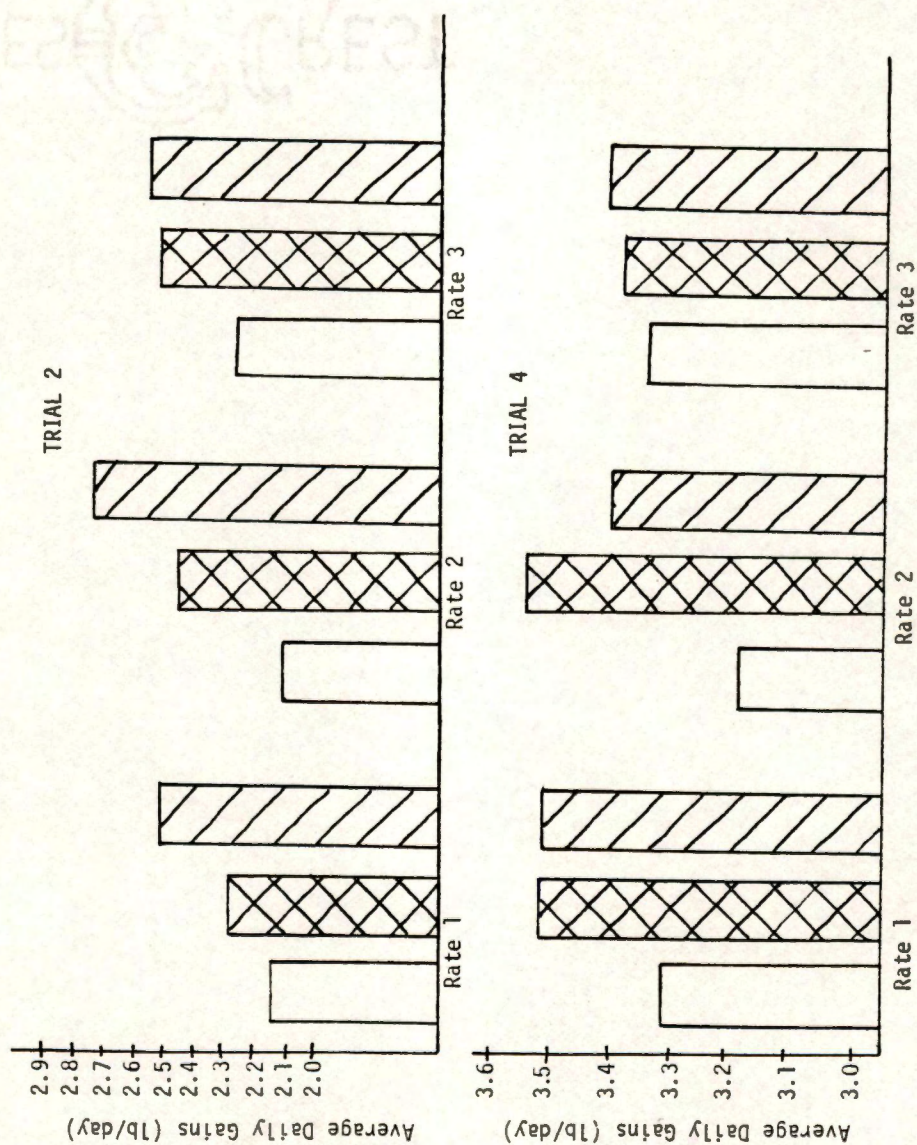


Figure 1. Mean average daily gains for the steers of the Highland Rim Experiment Station, trials 2 and 4. The average daily gains are grouped by treatment within each rate of gain group. □ Treatment 1; ▨ Treatment 2; ▩ Treatment 3.

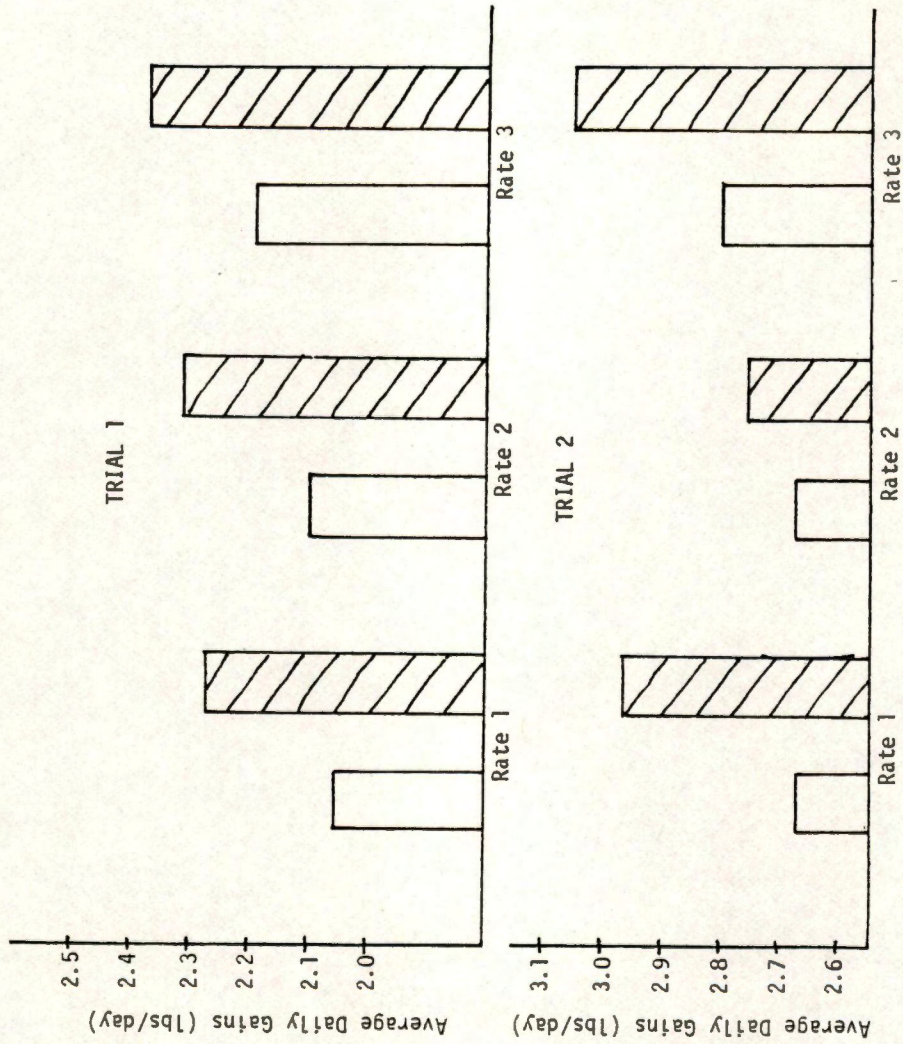


Figure 2. Mean average daily gains for the steers of the El Reno trials, trials 1 and 3. The average daily gains are grouped by treatment within each rate of gain group.

respectively and those at HRES were fed 240 and 96 days, respectively, during the 2 years. The initial feedlot weight was the feedlot arrival (off truck) weight which reflected an overall market-transit shrink of 9.39 to 10.76% in the various trials. Due to compensatory gains involved in recovery of market-transit shrink, the gains made in 1980 during the shorter feeding periods were inflated compared to those during the longer feeding period of 1979.

In each trial calves implanted with 36 mg of Ralgro[®] at the farm of origin tended to gain faster ($P < 0.05$ in three trials) in the feedlot (2.83 lb/day) than the non-implanted control calves (2.41 lb/day). Feedlot gains (2.97 lb/day) of the calves at HRES which were implanted at the farm of origin and reimplanted at the feedlot were similar to those (3.04 lb/day) of the HRES calves implanted only once at the farm of origin.

Analysis of variance to evaluate the effect of preshipment rate of gain and Ralgro[®] implants on postshipment feedlot gain indicated a significant interaction between the two effects. This interaction suggested that the response to Ralgro[®] implants was influenced by preshipment rate of gain. When the effect of Ralgro[®] implants was evaluated within each preshipment rate of gain group, calves classified as the slow rate of gain group exhibited a greater response (11.4%) to a single 36 mg Ralgro[®] implant at the farm of origin (greater improvement in average daily gain) than calves in the intermediate (10.4%) and highest (7.7%) preshipment rate of gain groups. During three of the four trials, preshipment gain significantly affected the increase in postshipment-feedlot rate of gain due to the Ralgro[®] implants. The percent improvement of each treatment over the controls for all trials can be seen in Table 2.

Table 2. Percent improvement in feedlot average daily gain of implanted calves over non-implanted controls.

Preshipment rate of gain group	Trial							
	1	2		3		4		
	Implanted once vs control	Implanted once vs control	Implanted twice vs control	Implanted once vs control	Implanted once vs control	Implanted twice vs control	Implanted once vs control	
1	10.8 ^a	17.6	5.5	10.7	6.3	6.3	6.3	
2	10.6	24.7	15.8	2.7	7.2	11.4	11.4	
3	8.3	12.8	11.7	8.9	1.9	0.9	0.9	

^aEach value represents the percent increase in gain observed in implanted calves in that shipment and preshipment rate of gain group over the nonimplanted calves in that respective class.

Summary

Calves were classified into three preshipment rate of gain groups on the basis of their gain the last 30 days at the farm of origin. The RATE groups were 1) the slowest gaining calves, 2) calves that gained at an intermediate rate, and 3) calves that gained the highest at the farm of origin. Part of the calves in each RATE group were implanted with 36 mg Ralgro[®] at the farm of origin and again upon arrival at the feedlot, part of the calves were implanted with 36 mg Ralgro[®] only at the farm of origin, and the remaining calves were not implanted.

Response to preshipment (postshipment feedlot gain) Ralgro[®] implants was greatest (2.5 to 5.4 percentage points) in the groups of calves that gained the slowest during the last 30 days at the farm (preshipment) than in those that gained at the fastest rate during this period. The intermediate rate of gain group was less consistent but the range in preshipment rate of gain varied with shipment. These results indicate that the greatest improvement in gain due to Ralgro[®] implants could be expected when calves gaining at a lower rate were implanted than when calves gaining at a higher rate were implanted, and agree with results of other researchers (Henson, 1970; Sharp and Dyer, 1971; Wilson et al., 1972; Jackson et al., 1974).

CHAPTER V

THE EFFECTIVENESS OF RALGRO[®] ON MARKET-TRANSIT SHRINK AND FEEDLOT ADAPTATION IN STRESSED FEEDER STEERS

Feeder cattle undergo various stresses throughout the market-transit system. Stressor agents, however, have a continuous impact upon the animal. Those stresses due specifically to the marketing-transit system are predisposing factors with respect to the shipping fever complex and are of major concern to feeder-calf producers. The economic losses in the United States due to shipping fever were estimated to be one-half billion dollars annually (Fleming, 1975).

Attempts have been made to identify the epizootology of shipping fever (Hoerlein and Marsh, 1957; Nichols, 1962; Hamdy et al., 1964a; Hamdy et al., 1965). Results of these studies have led to the recommendation of specific practices designed to reduce the incidence of the shipping fever complex (Greathouse et al., 1973; Herrick, 1969; Hoerlein, 1973; Norman, 1974; Koers et al., 1974).

The importance of Ralgro[®] implantation as a part of these preshipment practices is not fully understood. Smith et al. (1976) concluded that Ralgro[®] implantation moderated the physiological consequences of an 8 to 12 hr exposure to high temperatures. Brown et al. (1976) presented data that suggested implantation of Ralgro[®] may moderate the effects of heat stress. These results could be of importance to the well-being of market-transit stressed animals when subjected to certain environmental conditions involving high temperatures.

The objectives of this study were to evaluate the effect of preshipment Ralgro[®] implantation on market-transit shrink and feedlot adaptation of feeder calves exposed to normal industry weaning, marketing, and transporting stress.

Procedures

Steer calves ranging in weight from 275 to 640 lb were purchased from Tennessee feeder-calf producers. Approximately 30 days prior to transportation to an auction barn, the calves were weighed and assigned to Ralgro[®] implantation groups at their farm of origin (F0). These treatment groups were 1) non-implanted control, 2) implanted with 36 mg of Ralgro[®] at F0 and 3) implanted with 36 mg of Ralgro[®] at F0 and again upon arrival at the feedlot (AFL).

At F0 the calves were given a condition score, general health score, and rectal temperatures were measured. Two-thirds of the calves within each Ralgro[®] group were vaccinated against IBR. Upon arrival at the auction barn (AAB) one-half of the calves within each Ralgro[®] group which were vaccinated against IBR at F0 received a cell mediated immune booster.

The calves were assembled at an auction barn approximately 30 days after they were implanted at F0. At the auction barn the calves were weighed, rectal temperatures were measured, health and condition scores were taken and the calves were assigned a feeder grade by Tennessee State Department of Agriculture graders. The calves were tightly penned (3-12 ft²/calf) without access to hay or water for 24 hr to simulate an average auction barn environment.

Following this auction barn phase, the calves were allowed more pen space (18-30 ft²/calf) and given access to hay and water. During this 72 hr period orderbuyer barn conditions were simulated. Upon arrival at the orderbuyer barn (AOBB) and departure from the orderbuyer barn (DOBB), the calves were weighed, temperatures were taken, and health evaluations were made. The calves were then shipped to the respective feedlots.

In each of 2 years of this trial a group of calves were shipped to USDA-ARS Southwestern Livestock and Forage Research Center at El Reno, Oklahoma and another group was shipped to the Highland Rim Experiment Station (HRES) at Springfield, Tennessee. Calves in the El Reno shipments were subjected to treatment 1 and 2 only and those in the HRES shipments were subjected to all three preshipment treatments. Upon arrival at the feedlot in El Reno the calves were fed hay and grain to simulate gains of calves grazing wheat pasture. Upon arrival at the HRES the calves received a cottonseed meal, corn silage and hay diet.

Temperatures and weights were taken when the calves arrived at the feedlot (AFL). Those calves subjectively determined to be sick were treated and daily temperatures were taken until the calf was considered healthy. Weights taken during the 28 day feedlot adaptation period were used for this evaluation. Weight loss by the calves while in the auction barn (ABLOSS), weight gain during the orderbuyer barn (OBBG), weight loss during transport by truck to the feedlot (TRKLOSS), and total market-transit weight loss (MTLOSS) were determined for each calf. Weight gain during the feedlot adaptation period (FLGAIN), average daily gain during this period (ADG), and number of days required to regain purchase weight (DAYS) were also determined for each calf.

Analyses of variance procedures were used to determine the effects of the independent variables (F0, IBR and Ralgro[®] treatment) on the dependent variables (weight shrink, weight gains, and days to regain purchase weight). IBR treatments were included in the model to account for their effect, which was discussed by Wills (1980), and will not be discussed in this paper.

Results

The market-transit weight changes by Ralgro[®] treatment for each trial are shown in Figures 3 through 6. Mean weight gains and losses for each trial by treatment for the calves during specific segments of the market-transit chain are shown in Tables 3 and 4. FLGAIN, ADG, and DAYS for the feedlot adaptation period are also presented in Tables 3 and 4. Each shipment of this study will be examined as a separate trial.

The farm of origin (F0) significantly affected ($P < .001$) all market-transit weight changes (ABLOSS, OBBG, TRKLOSS, and MTLOSS) during trial 1. Ralgro[®] treatment did not significantly affect the market-transit weight changes, but the Ralgro[®] treatment farm interaction significantly affected TRKLOSS ($P < .05$). Mean weight changes for each treatment group during trial 1 are given in Table 3.

F0 affected total gain ($P < .05$) during the 28 day feedlot adaptation period. The response to Ralgro[®] implants in trial 1 were not significant with respect to FLGAIN. There was a trend for FLGAIN of implanted calves to be higher than FLGAIN of the control calves (48.5 vs 45.9 lb, respectively). The number of days required for calves to regain purchase weight were different for calves of various F0 ($P < .05$) and for calves

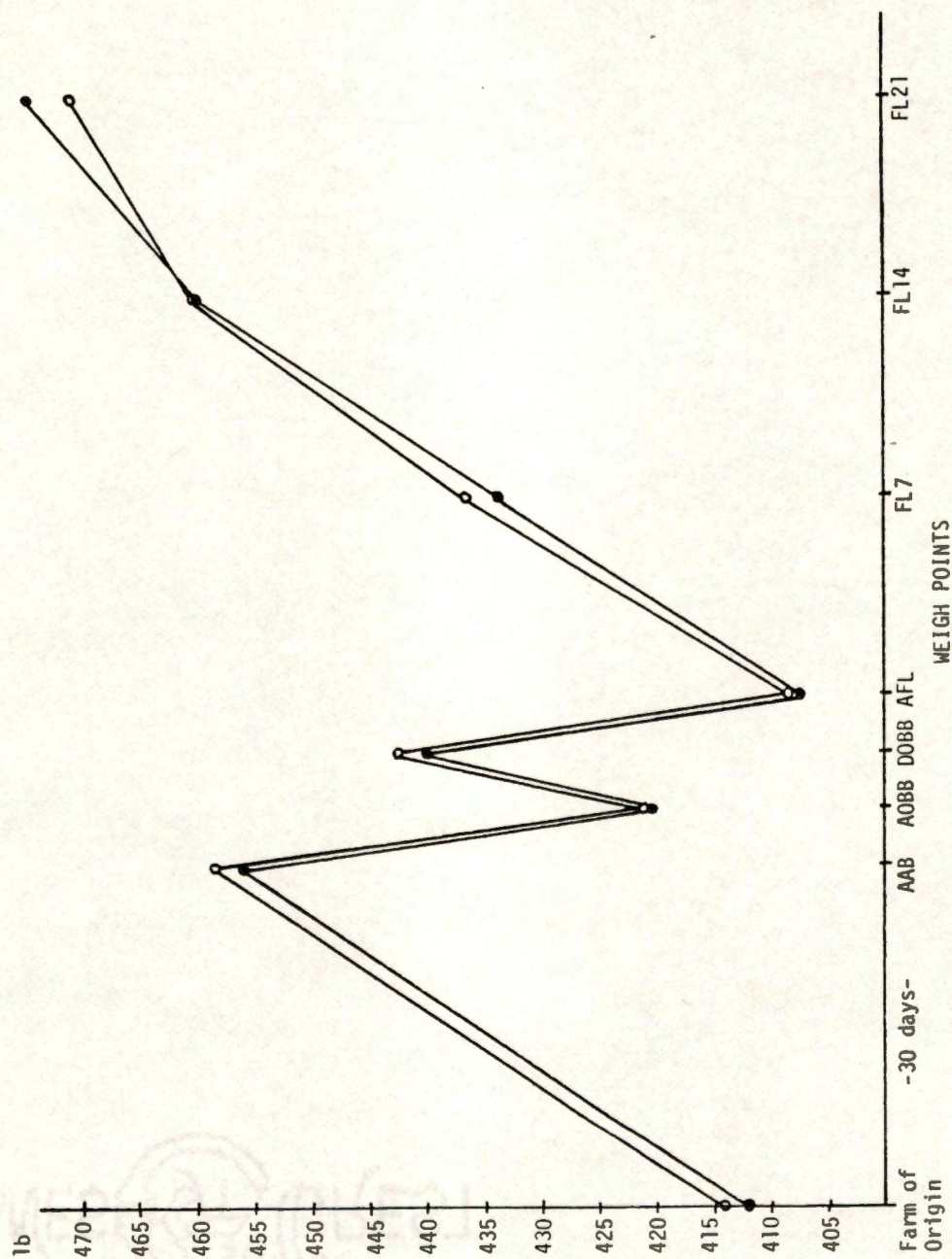


Figure 3. Comparison of market-transit and feedlot adjustment weight changes among treatments for trial 1. AAB--arrival auction barn; ADOB--arrival orderbuyer barn; DOBB--departure orderbuyer barn; AFL--arrival feedlot; FL7-21--feedlot days; O Treatment 1; ● Treatment 2.

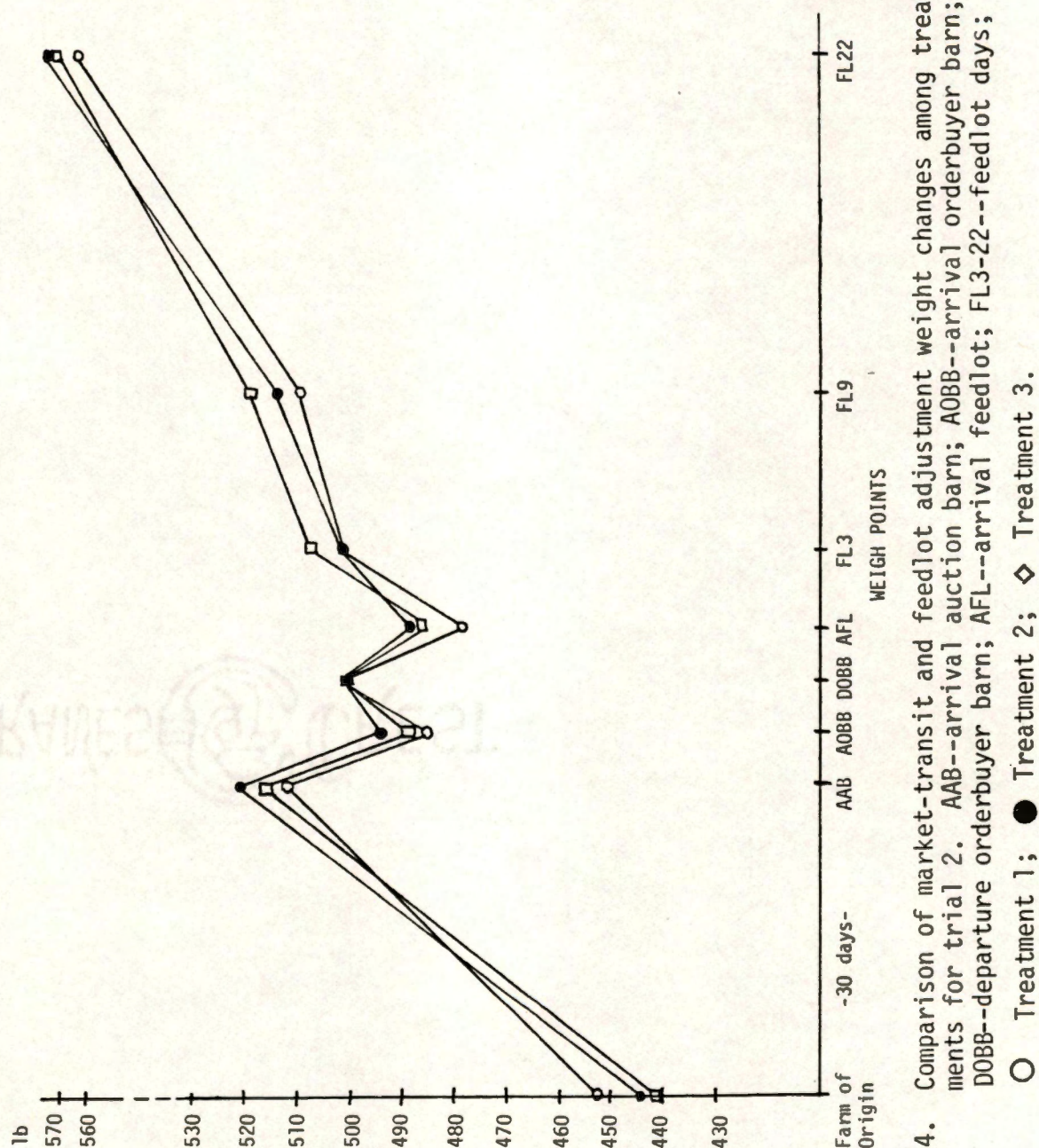


Figure 4. Comparison of market-transit and feedlot adjustment weight changes among treatments for trial 2. AAB--arrival auction barn; A0BB--arrival orderbuyer barn; D0BB--departure orderbuyer barn; AFL--arrival feedlot; FL3-22--feedlot days;

○ Treatment 1; ● Treatment 2; ◇ Treatment 3.

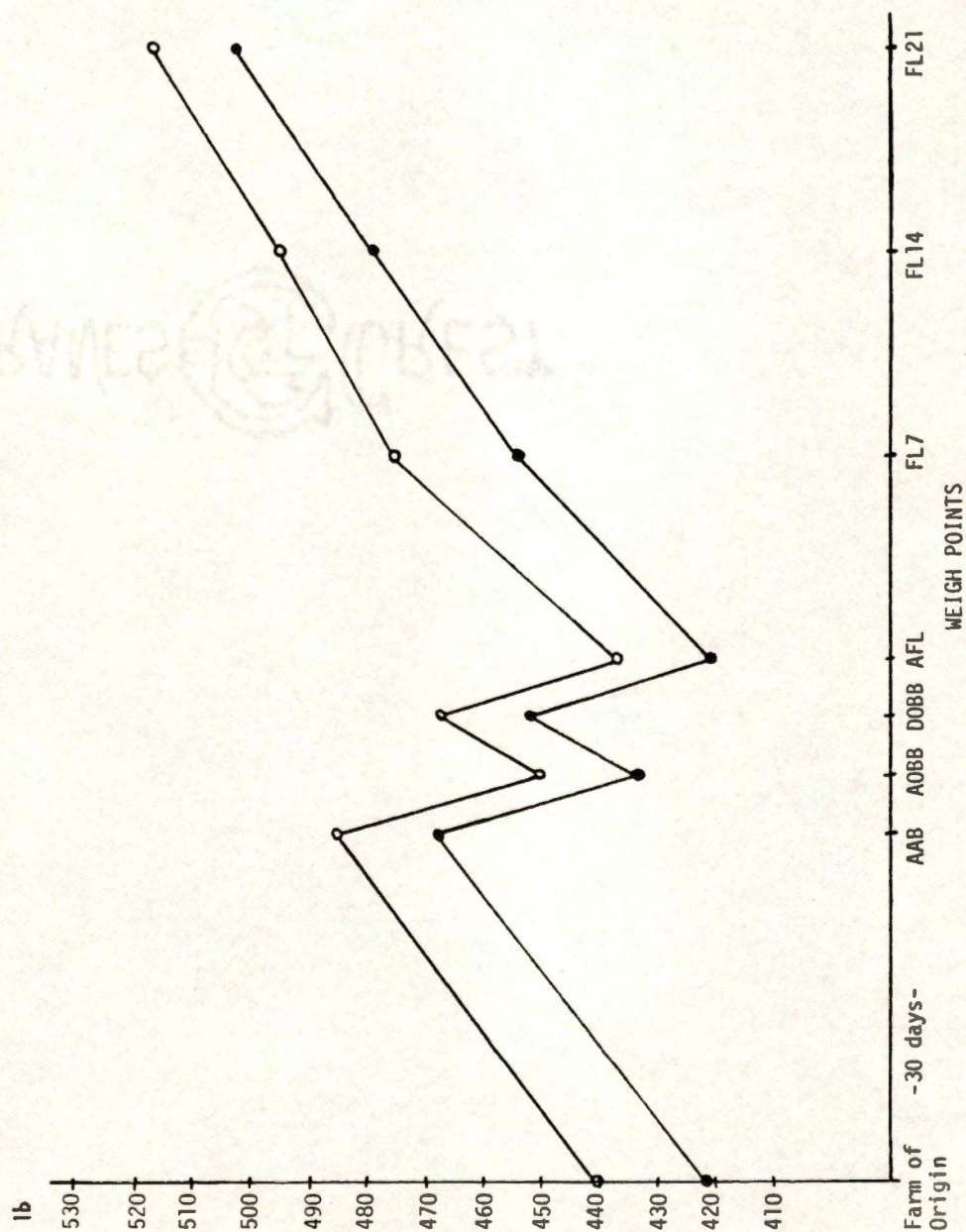


Figure 5. Comparison of market transit and feedlot adjustment changes among treatments for trial 3. AAB--arrival auction barn; AOB--arrival orderbuyer barn; DOBB--departure orderbuyer barn; AFL--arrival feedlot; FL7-21--feedlot days;
 ○ Treatment 1; ● Treatment 2.

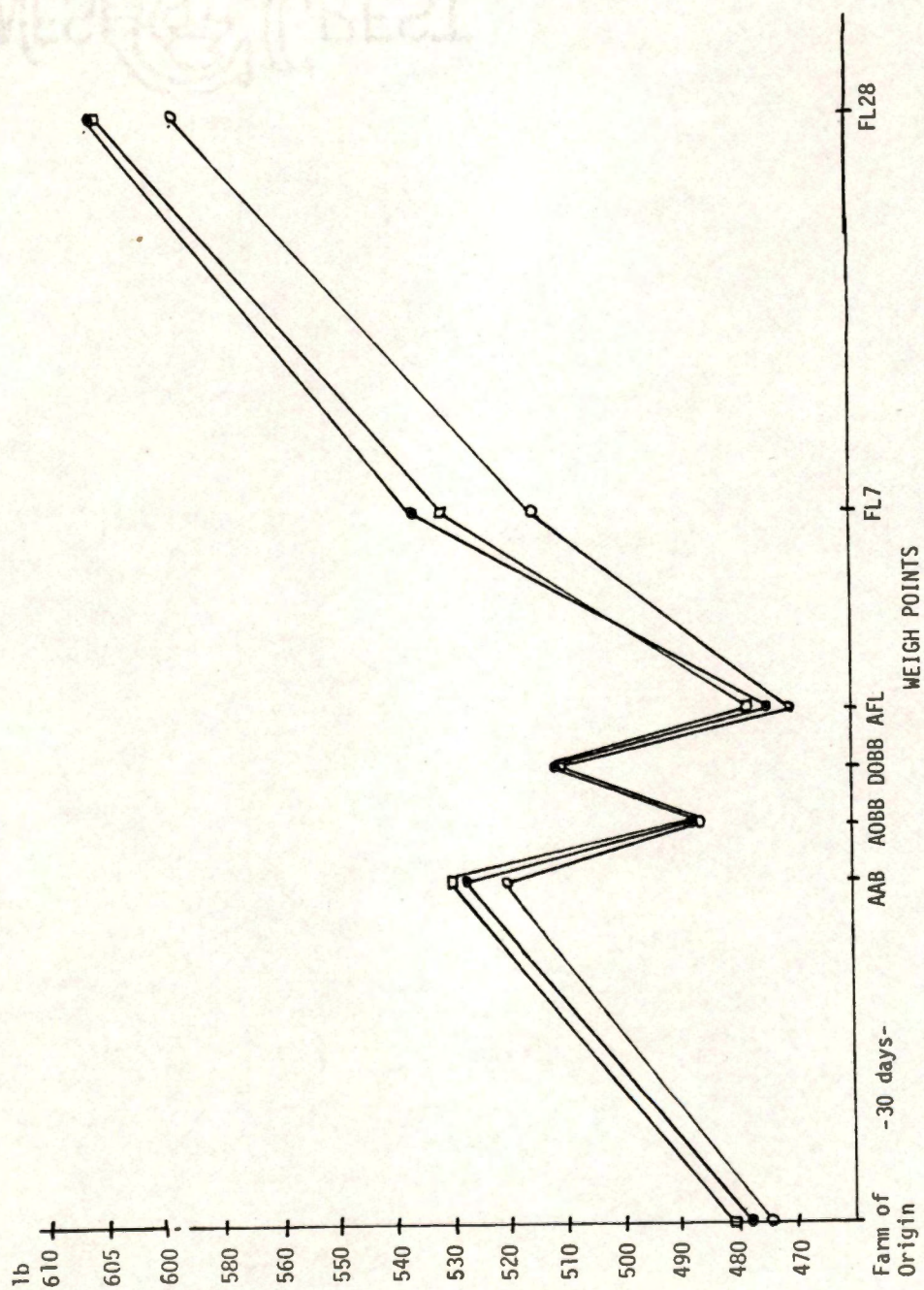


Figure 6. Comparison of market-transit and feedlot adjustment weight changes among treatments for trial 4. AAB--arrival auction barn; AOB--arrival orderbuyer barn; DOBB--departure orderbuyer barn; AFL--arrival feedlot; FL7-28--feedlot day through;

○ Treatment 1; ● Treatment 2; ○ Treatment 3.

Table 3. Market-transit weight changes and feedlot adaptation for calves shipped to E1 Reno.

Item	Trial 1		Trial 3	
	Non-implanted	Implanted at F0	Non-implanted	Implanted at F0
ABLOSS (lbs)	36.7	35.8	35.1	34.4
OBGG (lbs)	21.6	19.9	16.9	18.6
TRKLOSS (lbs)	34.2	32.7	30.2	31.7
MTLOSS (lbs)	49.3	48.6	48.4	47.4
DAYS	32.9	31.7	15.7	15.5
ADG (lbs/day)	1.64	1.73	3.19	3.34
FLGAIN (lbs)	45.9	48.5	89.3	93.5

Table 4. Market-transit weight changes and feedlot adaptation for calves shipped to HRES.

Item	Trial 2			Trial 4		
	Control	Implanted at FO	Implanted at FO and AFL	Control	Implanted at FO	Implanted at FO and AFL
ABLOSS (lbs)	26.7	26.7	26.9	33.9 ^d	40.3 ^{cd}	43.6 ^c
OBBG (lbs)	16.4 ^a	7.8 ^b	12.2 ^{ab}	23.6	24.7	25.3
TRKLOSS (lbs)	22.8 ^a	13.3 ^b	15.3 ^b	38.6	37.5	32.8
MTLOSS (lbs)	33.1	32.2	30.0	48.9	53.1	51.1
DAYS	10.8 ^c	9.3 ^{cd}	7.9 ^d	13.4	14.0	14.3
ADG (lbs/day)	3.30 ^d	3.57 ^{cd}	4.0 ^c	3.53	3.76	3.60
GAIN (lbs)	92.5 ^d	99.8 ^{cd}	112.2 ^c	98.9	105.3	100.9

^{ab}Means within a row for each trial with different superscripts are significantly different ($P < .05$).

^{cd}Means within a row for each trial with different superscripts are significantly different ($P < .1$).

subjected to various IBR treatments ($P < .1$). Although the effects of Ralgro[®] implants were not significant, calves implanted at F0 required fewer days (31.7) than non-implanted calves (32.9) to regain purchase weight.

OBBG of calves in trial 2 was affected by Ralgro[®] treatment ($P < .05$). The control calves gained 16.4 lb compared to 7.8 lb for calves implanted at F0 and 12.2 lb for calves implanted at F0 and again upon arrival at the feedlot. Ralgro[®] treatment also affected TRKLOSS ($P < .001$) as did F0 ($P < .01$). Non-implanted calves lost 22.8 lb while implanted calves of treatments 2 and 3 lost 13.3 and 15.3 lbs, respectively. F0 also affected MTLOSS ($P < .05$).

F0 as well as Ralgro[®] treatment affected the gain of the calves during the feedlot adaptation period ($P < .05$). The ADG for the calves implanted at F0 and reimplanted at AFL was greater ($P < .05$) than for the non-implanted control calves or those implanted only at F0 (4.00 lb/day vs 3.57 and 3.30 lb/day, respectively). Gain for calves implanted at F0 and AFL (112.2 lb) was greater ($P < .05$) than for calves implanted at F0 only (99.8 lb) and non-implanted calves (92.5 lb). F0 and Ralgro[®] treatment affected the number of days required for calves in this trial to regain purchase weight ($P < .001$) as did Ralgro[®] treatment ($P < .1$). The control calves required longer (10.8 days) than calves in either of the implanted groups to regain purchase weight (9.3 and 7.9 days, respectively).

Auction barn loss, orderbuyer barn gain, truckloss and total market-transit loss for each treatment in trial 3 are presented in Table 3.

Farm of origin significantly affected the number of calves which were

subjectively determined to be sick ($P < .01$). The Ralgro treatment F0 interaction approached significance for FLGAIN during the feedlot adaptation period, but Ralgro[®] treatment did not. However, the calves implanted at F0 only did have higher gains than the non-implanted calves (93.5 vs 89.3 lb, respectively). The number of days required to regain purchase weight was affected by F0 ($P < .001$). There was a trend for implanted calves to require fewer days to regain purchase weight than non-implanted calves.

In trial 4, F0 also affected auction barn loss, orderbuyer barn gain and market-transit loss ($P < .001$). The F0 Ralgro[®] treatment interaction affected auction barn weight loss ($P < .05$) and total market-transit loss ($P < .01$). The number of days required to regain purchase weight was affected by F0 ($P < .001$) and by F0 treatment interaction ($P < .01$), but not by Ralgro[®] treatment. The trend observed in the other trials for the number of days to regain purchase weight to be less for implanted calves than for control calves was not observed in this trial.

Summary

The effectiveness of Ralgro[®] as an agent to aid in the reduction of market-transit weight loss and to improve feedlot adaptation of market-transit stressed calves was studied. Farm of origin had a significant influence on total market-transit weight changes in three of the four individual trials. Total market-transit weight loss tended to be lower in implanted calves than in control calves in the first three trials. Ralgro[®] implantation at the farm of origin did not reduce weight shrink during the auction barn phase. In each of the El Reno shipments (trials

1 and 3) the implanted calves tended to lose less weight in the auction barn than the control calves. No consistent trend with respect to weight gain in the orderbuyer barn was noted.

In all trials, the implanted calves lost less weights on the truck than did the control calves; however, this difference was only statistically significant in trial 2.

Calves from different farms of origin required a different number of days to regain purchase weight ($P < .001$) in all trials. During three of the four trials implanted calves tended to require fewer days to regain purchase weight. Gain during the feedlot adjustment period in each trial was greater for the implanted calves over the non-implanted calves.

These results indicate that the calves implanted with Ralgro[®] gain faster and recover purchase weight earlier than non-implanted calves during the 28-day feedlot adjustment period. Market-transit weight changes were quite variable, but the trends indicated that calves implanted at the farm of origin with Ralgro[®] were more resistant to the market-transit stresses and arrived at the feedlot in a more healthy condition than non-implanted calves.

CHAPTER VI

THE EFFECT OF RALGRO[®] IMPLANTATION ON FEEDLOT
PERFORMANCE OF STEER CALVES SUBJECTED TO
MARKET-TRANSIT STRESS

The anabolic agent Ralgro[®], in which the active component is zeranol, has been extensively studied by various researchers. Much of this research involves examination of the growth promoting properties of Ralgro[®] in cattle (Perry et al., 1970; Borger et al., 1973a; Ralston, 1978; Brethour, 1979; Corah, 1979). These studies have involved young calves, growing calves, and feedlot cattle. However, few studies have been conducted to evaluate the effect of preshipment Ralgro[®] implants on postshipment feedlot performance of stressed steers.

The effect of Ralgro[®] implants on weight gain, average daily gain, feed efficiency and carcass characteristics have all been reported (Perry et al., 1970; Sharp and Dyer, 1970; Wilson et al., 1972; Bennett et al., 1974; Wiggins et al., 1979). During this study, the above variables (excluding carcass data) were measured at various points in the market-transit chain and during the feedlot finishing period to determine the effect of various levels of preshipment Ralgro[®] implantation upon postshipment feedlot performance of market-transit stressed calves. The treatment groups were: 1) a non-implanted control group, 2) a group implanted with 36 mg Ralgro[®] at the farm of origin, and 3) a group implanted with 36 mg Ralgro[®] at the farm of origin and again upon arrival at the feedlot.

Procedures

During 1979 and 1980, steer calves ranging in weight from 275 lb to 640 lb were purchased from Tennessee cow-calf producers. The calves were weighed, rectal temperatures were taken, health scores were assigned and the calves were assigned to a treatment group while at their farm of origin. The calves of treatments 2 and 3 were implanted at this time. Thirty days later all calves were assembled at the Algood Livestock Market in Algood, Tennessee. Weights and rectal temperatures were taken as the cattle arrived. Feeder calf grades were assigned by Tennessee State Department of Agriculture Feeder-Calf Graders.

For the next 24 hr, the calves were subjected to an auction barn environment and then subjected to 72 hr of an orderbuyer barn environment. During the auction barn phase, the calves were tightly penned (8 to 12 ft²/calf) without access to hay and water. During the orderbuyer barn phase, the calves were allowed more space (18 to 30 ft²/calf) and were given access to hay and water. Weights, rectal temperatures and health scores were recorded for each calf upon arrival and departure from each environmental phase.

Each year, following the auction and orderbuyer barn phase, the calves were shipped to wheat pasture at either the USDA-ARS Southwestern Forage and Livestock Center at El Reno, Oklahoma or to a feedlot at The University of Tennessee, Highland Rim Experiment Station (HRES) at Springfield, Tennessee. Upon arrival at the HRES feedlot, the calves were fed a receiving diet of cottonseed meal, corn silage, cracked shelled corn, and hay for about 21 days. After feedlot day 7, corn silage was fed in increasing amounts and hay was deleted from the diet. After

about 140 days of this growing phase, the corn silage, cottonseed meal, and cracked corn diet was replaced with whole shelled corn plus a protein supplement designed to be fed with whole shelled corn. This is the diet which the cattle consumed to slaughter condition. When wheat pasture was not available, calves at the El Reno feedlot were fed a hay-concentrate diet at levels designed to simulate gains of calves grazing wheat pasture.

Upon arrival at the feedlot, weights and rectal temperatures were again taken. Sick calves were treated as necessary. Periodic weights were taken during the subsequent feedlot period. The dates at which feedlot weights were taken depended upon year and trial.

At HRES, the calves were penned in groups of six with three pens per treatment. Feed consumption was recorded by pen and feed efficiency was calculated. However, due to the procedures used to pen the calves at El Reno in order to satisfy objectives of another part of the experiment, feed data was not available for these trials.

Slaughter weights were taken on the same day when all calves reached slaughter condition. Carcass weights were recorded and individual dressing percentages were calculated.

Analyses of variance procedures were used to calculate the effects of the independent variables (Ralgro[®] implant and IBR treatment) and their interaction on the dependent variables (weight gain, feed efficiency, dressing percent). Duncans multiple range test was used for mean separation when differences occurred among means.

Results

In this discussion shipment will be considered as a separate trial. In trial 1, no difference due to Ralgro[®] implants were observed for calf gains during the 30-day period on the farm prior to transport to the auction barn. From feedlot day 58 to feedlot day 297 when the calves were slaughtered the implanted calves gained faster ($P < .01$) than the non-implanted control calves. The weight gains for the implanted calves of trial 1 prior to feedlot day 58 were greater than the non-implanted calves, but the difference was not significant. Shown in Table 5 are the mean feedlot gains by treatment. The effects of farm of origin on the feedlot gains was more significant during the early feedlot period ($P < .01$), and the effect decreased as the time on feed increased but remained significant throughout the feedlot period ($P < .05$).

Both farm of origin and Ralgro[®] implant treatment affected the carcass weight of the calves. Mean carcass weight of the implanted calves was 633.7 lb and 669.9 lb for non-implanted calves ($P < .001$). This difference was a reflection of the increased feedlot weight gain. Dressing percent was affected by farm of origin ($P < .1$), but no treatment differences were observed (63.4% for both treatments).

The following year, calves of trial 3 also were shipped to El Reno, Oklahoma. Data for this trial were collected only to day 56 of the feedlot. Treatment proved to be significant ($P < .1$) for the weight gained by the calves to feedlot day 56. All other gains prior to this, including the 30-day weight gain while at the farm of origin but excluding the weight gain during the first week at the feedlot, were greater for the implanted calves. Presented in Table 5 are the mean gains by treatment for trial 3.

Table 5. Cumulative gains to specific feedlot days for calves shipped to El Reno.

Feedlot Day	Trial 1		Feedlot Day	Trial 3	
	Treatment Gain (lb)			Treatment Gain (lb)	
	Non-Implanted	Implanted		Non-implanted	Implanted
7	29.2	27.1	7	37.8	33.1
21	66.0	71.2	14	57.5	57.9
58	153.8 ^a	168.9 ^b	21	79.1	81.9
109	215.3 ^a	229.2 ^b	28	89.3	93.5
153	257.2 ^a	274.5 ^b	42	135.4	144.8
183	358.5 ^a	395.2 ^b	56	152.4 ^c	163.9 ^d
297	633.2 ^a	693.2 ^b			

^{ab} Means within a row for each trial with different superscripts are significantly different ($P < .01$).

^{cd} Means within a row for each trial with different superscripts are significantly different ($P < .1$).

The calves of trial 2, a 1979-1980 HRES trial, exhibited many of the same trends as the El Reno calves. Treatment did not cause a significant effect on feedlot gains until day 21 of the feedlot ($P < .05$) and by the end of the feedlot period, day 245, treatment was highly significant ($P < .001$). From day 21 of the feedlot to the final feedlot day, the implanted calves gained more weight than the non-implanted control calves, as demonstrated in Table 6.

Treatment affected the feed efficiency of the calves while in the feedlot ($P < .001$). As presented in Table 7, the mean feed efficiencies by treatment are greater for the non-implanted control calves. This effect is greatest when the entire feedlot period was considered. The treatment group implanted twice exhibited no significant improvement in feed efficiency over the treatment group implanted once. No consistent effect of treatment on feed consumption was observed.

The calves of trail 4 were also transported to the HRES. Treatment affected feed efficiency for the calves during this 185-day feedlot period ($P < .001$). Feed efficiency for the non-implanted controls was greater ($P < .01$) than the implanted calves. Presented in Table 7 are the treatment means for feed efficiency. Again as in trial 2, no significant affect of treatment on feed consumption occurred.

The calves of the control group gained less weight than the implanted calves although not significantly. This includes the weight gain on the farm of origin during the 30 days prior to transport to the auction barn, through the weight gain to day 185 of the feedlot. The treatment means are presented in Table 6.

Table 6. Cumulative gains to specific feedlot days for calves shipped to HRES.

Feedlot Day	Trial 2			Feedlot Day	Trial 4		
	Non-Implanted	Implanted Once	Implanted Twice		Non-Implanted	Implanted Once	Implanted Twice
3	23.7	12.7	20.9	7	43.6	61.1	52.7
9	30.2	24.6	32.6	35	123.6	131.7	126.1
21	72.7	78.4	88.2	47	166.7	175.0	168.3
86	194.8	211.8	215.6	89	266.1	275.0	270.0
147	427.8 ^b	495.0 ^a	459.7 ^a	185	316.9	331.7	335.6
245	522.2 ^b	627.9 ^a	589.4 ^a				

^{ab}Means within a row for each trial with different superscripts are significantly different (P < .01).

Table 7. Treatment means of feed efficiency for calves shipped to HRES.

Feedlot Day	Trial 2			Trial 4			
	Non-Implanted	Implanted Once	Implanted Twice	Feedlot Day	Non-Implanted	Implanted Once	Implanted Twice
21	3.1 ^a	2.8 ^b	2.6 ^c	35	2.5 ^a	2.3 ^a	2.5 ^a
147	3.6 ^a	3.1 ^b	3.2 ^b	89	3.9 ^a	3.8 ^a	3.9 ^a
245	5.7 ^a	5.1 ^b	4.9 ^b	185	4.6 ^a	4.4 ^b	4.4 ^b

^{abc}Means within a row for each trial with different superscripts are significantly different (P < .01).

Summary

The influence of preshipment Ralgro[®] implantation on performance of steer calves during market-transit stress and during the subsequent adaptation and feedlot period was studied.

In all trials calves implanted with 36 mg Ralgro[®] at F0 gained more rapidly during the total finishing period than the non-implanted calves.

No differences in dressing percentages among Ralgro[®] implant treatments were observed. Carcasses of calves implanted at F0 were significantly heavier ($P < .001$) than the carcasses of the non-implanted calves. This disagrees with results reported by Wiggins et al. (1979), who reported that zeranol implantation had no significant effect on carcass weight.

In calves shipped to HRES, Ralgro[®] treatment significantly affected feed efficiency ($P < .01$). The implanted calves were the more efficient compared to non-implanted calves. This difference was greatest when the entire feedlot period was considered. These results agree with the results of Sharp and Dyer (1971), but the differences in this trial was less.

Ralgro[®] implants did not significantly affect feed consumption. Differences in feed consumption were inconsistent throughout the feeding period at HRES. These results agree with those of Thomas and Arritage (1970), Sharp and Dyer (1970), Hathaway et al. (1973), Borger (1973), Wiggins et al. (1976), Wiggins et al. (1979).

Reimplanting calves with 36 mg Ralgro[®] upon arrival at the feedlot did not improve feedlot performance above that of calves implanted at F0 only. This is true for both weight gains and feed efficiency.

CHAPTER VII

SUMMARY

Data used for this study were obtained from 397 steer calves, weighing 275 lb to 640 lb, purchased from 9 Tennessee cow-calf producers. Thirty days prior to marketing all calves were weighed and assigned to treatment groups at their farm of origin. The treatment groups were: 1) a non-implanted control group, 2) a group implanted with 36 mg Ralgro[®] at the farm of origin, and 3) a group implanted with 36 mg Ralgro[®] at farm of origin and again upon arrival at the feedlot.

Each year the calves were transported from their farm of origin to an auction barn where weights were again taken and Tennessee State Department of Agriculture Feeder-Calf Graders assigned grades to the calves. During the first 24 hr in the auction barn an auction barn environment was simulated by having the calves in close confinement without feed or water. Weights were taken at the end of the auction barn phase and the calves were then subjected to a 72 hr orderbuyer barn phase. The orderbuyer barn environment was simulated by allowing the calves more space, 18 to 30 ft² each, and access to hay and water. Weights were again taken following this phase. The calves were then shipped to the Highland Rim Experiment Station at Springfield, Tennessee or to the USDA-ARS Southwestern Livestock and Forage Research Center at El Reno, Oklahoma.

Upon unloading at the feedlot, calves were weighed, health scores were determined and the calves were assigned to pens. The calves at HRES were fed a receiving diet of hay, cottonseed meal, corn silage

and hay, and were finished on a diet of whole grain corn and a protein supplement. The calves at El Reno were fed a hay-grain diet designed to simulate gains of calves grazing wheat pasture. These calves were finished in a feedlot at USDA Southwestern Great Plains Research Center, Bushland, Texas.

Preshipment rate of gain influenced the effectiveness of the Ralgro[®] implant. Steers classified to the slow rate of gain group exhibited greater response to the Ralgro[®] implant over the controls than did calves classified to the fast rate of gain group in three of four shipments. Implanted calves of the slow and intermediate rate group had weight gains comparable to those of the fast rate group. Ralgro[®] implantation tended to reduce weight loss incurred during the market-transit system and calves implanted required fewer days to regain purchase weight at the feedlot. The implanted calves of all trials lost less weight on the truck during shipment from the orderbuyer barn to the feedlot than did non-implanted control calves. Ralgro[®] implantation did not influence market-transit morbidity or other health parameters.

Implanted calves gained more weight at the feedlot in all four trials and were more feed efficient in the two trials in which these data were recorded. No difference in total feed consumption attributable to Ralgro[®] implants were observed during the feedlot periods.



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