Iowa State Beef Checkoff Research Program
Final Report

I. COVER PAGE

Title of project:
Effects of Market Timing and Performance Technologies on Marketing Decisions for High Quality Midwest Cattle

Investigators:
Iowa Beef Center, Iowa State University Extension and Outreach

Erika Lundy-Woolfolk	**Dan Loy**
SW IA Field Specialist	Director
154 Public Sq., Suite C	313E Kildee Hall
Greenfield, IA 50849	Ames, IA 50011
Phone: 641-745-5902	Phone: 515-294-1058
Email: ellundy@iastate.edu	Email: dloy@iastate.edu

Project timeline:

Initiation:	December 2022
Live animal initiation:	March 2023
Live animal completion:	July 2023
Completion:	November 2023

Budget:

Awarded	$ 18,863
Spent	$ 17,267
Remaining funds	$ 1,596

II. NONTECHNICAL SUMMARY

To maximize carcass quality, cattle are often fed longer at the expense of reduced performance and higher cost of gain. Therefore, there is a need to evaluate the tradeoffs related to days on feed and market timing contingent on feed costs and grid premiums and discounts for high quality cattle sold on a carcass or grid market basis.

One hundred and eight steers were utilized in 3 X 2 factorial study with treatments consisting of three harvest dates resulting in varying backfat endpoints and two implant strategies (CHO = moderate potency implant vs. PLU = high potency implant). Steers were fed a common finishing diet with carcass ultrasound utilized to track external and internal fat deposition. The first marketing group was set for harvest on day 68 when the group average had an ultrasound estimated 12^{th} rib backfat thickness (RF) of 0.5 inches (MKT1). The second and third marketing groups were also scheduled at the same time as MKT1 for day 84 (MKT2) and 112 (MKT3) respectively.

While implant did not impact ribeye area (REA), steers implanted with CHO continued to build internal fat deposition with each marketing date. However, carcass intramuscular fat of PLU-implanted steers leveled off after MKT1 and resulted in steers harvested on MKT3 having lower marbling scores than those marketed on MKT2. The most likely driver of this is the unexpected poorer ADG (0.64 lbs./hd) of PLU-implanted, MKT3 steers compared to other marketing groups of the same implant.

Intake was not impacted by implant or marketing date. Steers that received the higher potency PLU implant tended to have improved feed conversion compared to CHO-implanted steers (6.32 vs. 6.81 lbs. of feed per lb. of gain) and heavier hot carcass weights. Results of this study suggest that higher potency implants do result in added growth performance benefits but did slightly hinder carcass quality compared to a moderate potency implant (Figure 1).

With today's average feed prices ($300/ton, dry matter basis) and high Prime premiums ($25/cwt), feeding cattle longer results in greater returns per head (Figure 2). For the CHO-implanted steers, there was nearly a $120/hd spread amongst the three marketing dates, largely driven by the increase in Prime carcasses from 18% on MKT1 to 70% on MKT3. For the PLU-implanted steers, MKT2 was substantially more profitable due to exceptional growth performance and 42% of the steers grading Prime. However, those returns were lost by the MKT3 due to reduced growth and carcass performance.

In scenarios with higher feed prices, there are narrow margins for feeding cattle regardless of grid premiums, but marketing cattle at interim weights return the least amount of losses. With lower feed costs, feeding cattle with high-quality carcass genetics to heavier weights increases profit potential.

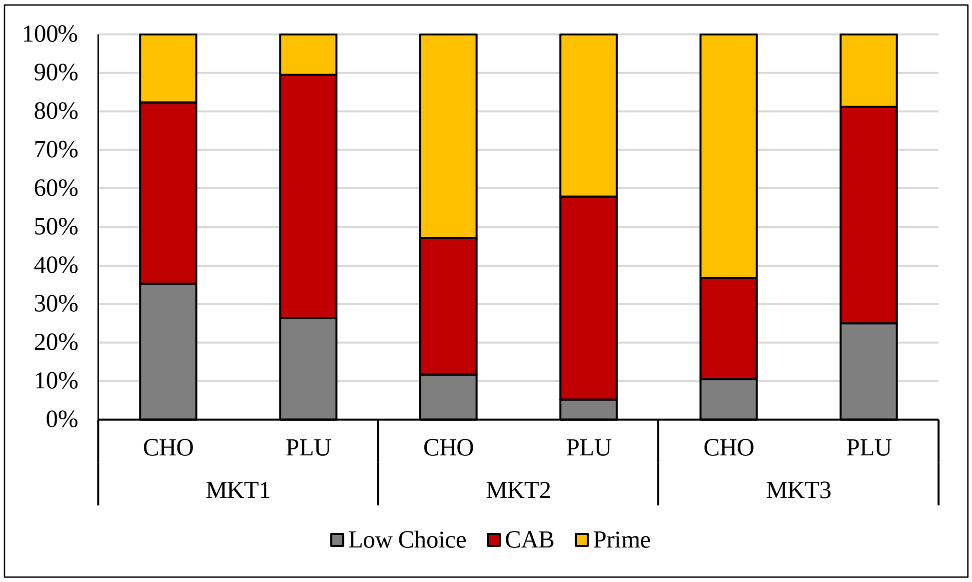

Figure 1. Quality grade distribution of steers based on implant strategies and market end point[1]

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; CAB = Certified Angus Beef (average or high Choice)

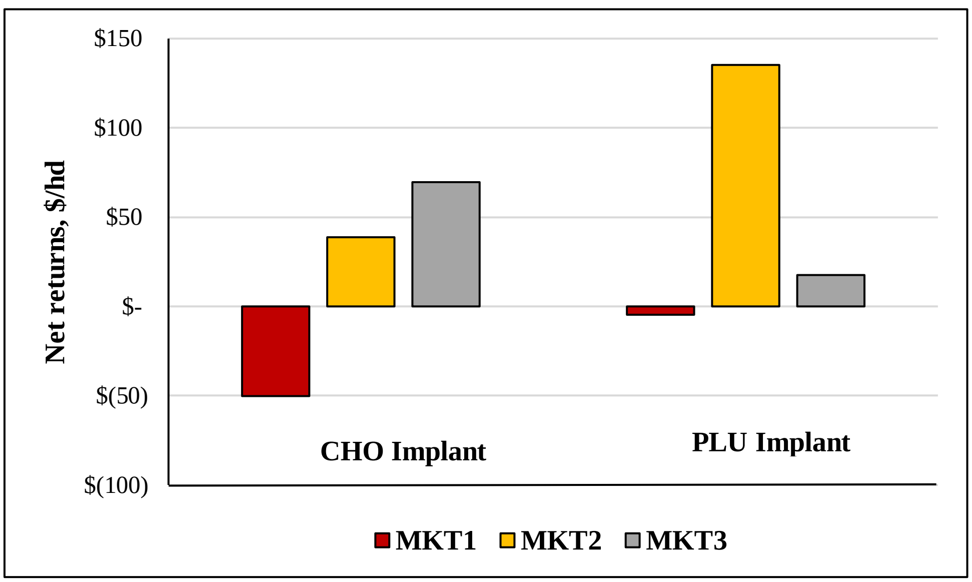

Figure 2. Net returns per head based on implant strategies and market end point[1]

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; CAB = Certified Angus Beef (average or high Choice)

III. TECHNICAL REPORT

a. Impact

Genetics for carcass grading improves each year resulting in more Prime and upper Choice carcasses. Even with the greater supply, consumer demand and grid premiums for high quality beef remains strong. While previous Iowa State Beef Checkoff funded research has demonstrated that high quality beef can be produced efficiently and economically using modern growth technologies including implants and nutrition programs, questions still exist about optimal strategies from cattlemen in the Midwest who are often chasing Prime premiums. The study aimed to evaluate the tradeoffs related to days on feed and market timing contingent on feed costs and grid premiums and discounts for high quality cattle sold on a carcass or grid market basis.

This study and economic analysis will aid beef producers in making more informed marketing decisions of cattle capable of generating quality premiums with varying carcass premiums and discounts as well as changing feed costs.

b. Methods and Results

Methods

One hundred and eight purebred Angus steers sourced from the ISU McNay Research Farm breeding project were utilized in 3 X 2 factorial study at the ISU Armstrong Research Farm near Lewis, Iowa. Treatments consisted of three harvest dates resulting in varying backfat endpoints and two growth technologies consisting of a low potency trenbolone acetate (TBA) implant (CHO; Synovex Choice containing 100 mg of TBA and 14 mg estradiol benzoate) compared to a high potency TBA implant (PLUS; Synovex Plus containing 200 mg of TBA and 28 mg of estradiol benzoate). The study objective was to evaluate the effects of market timing and fat thickness endpoint on performance, carcass traits and economics with different feed costs and market premiums.

Prior to study initiation, 124 steers were backgrounded on a common diet for approximately 120 days at the ISU Armstrong Research Farm. On day (d) -7, individual body weights (BW) and carcass ultrasound measurements to determine ribeye area (REA), intramuscular fat (IMF), and 12^{th} rib backfat thickness (RF) were collected. Utilizing carcass ultrasound, age, marbling potential based on parent expected progeny differences (EPD), and average initial BW of consecutive day weights on d-1 and d0, steers were randomly assigned to implant and marketing date treatments (n = 18 hd/trt). On d0 of the study, half of the steers (n = 54 hd) within each pen were implanted with CHO (Synovex Choice containing 100 mg of TBA and 14 mg estradiol benzoate) with the remaining half (n = 54 hd) implanted with PLUS (Synovex Plus containing 200 mg of TBA and 28 mg of estradiol benzoate).

At the research feedyard, two pens are equipped with individual feed intake measurement bunks while the other two pens are traditional open bunks. Steers in the individual intake units were managed to have *ad libitum* feed access while steers in the open bunks were managed to have slick bunks 3-5 days a week. All steers were fed the same diet consisting of 8% hay, 30% modified distillers, 58% whole corn, and 4% supplement on a dry matter basis (Table 1).

Table 1. Ingredient composition of diet fed (%, dry matter basis)

	%
Corn	58.0
MDGS	30.0
Hay	8.0
Supplement	4.0
Analyzed composition	
Crude protein	16.8
peNDF	5.5
NEg, Mcal/lb	0.64

Steers were weighed and carcass ultrasounded to monitor changes in external and internal fat deposition on d 28, 56, 84, and 112. Ultrasound images were sent to the CUP Lab (Centralized Ultrasound Processing Lab, Ames, IA) for interpretation of REA, IMF, and RF. Based on ultrasound external fat measurements, the first market date was scheduled for d 68. At the same time, the second and third dates were scheduled for d96 and 124 respectively. Ultrasound average RF measurements were 0.48 inches of RF on d56, 0.55 inches on d84, and 0.64 for 112.

Steers were harvested at a local packing plant (Iowa Premium, Tama, IA) where individual carcass data including hot carcass weight (HCW), RF, REA, marbling score (MS), quality grade (QG), and yield grade (YG) were collected. A carcass adjusted final BW was calculated utilizing individual steer HCW and a standardized dressing percentage of 63%. For the cattle in the individual intake bunks, DMI, BW, ADG and feed conversion (F:G) were calculated on an individual steer basis. For steers in the open bunks, dry matter intake was calculated on pen basis. The pen average intake coupled with individual BW were utilized to calculate individual steer ADG and F:G. Data from both steers in the open bunk and individual intake bunks were compiled in the economic analysis.

Steer growth and carcass performance results were compiled for use in sensitivity tables to evaluate optimum market end points at varying feed costs as well as premiums and discounts for carcass quality. Researchers utilized 10-year spread on corn price, carcass premium and carcass discounts to capture variation in markets. USDA market reports were utilized to estimate feeder calf prices and grid base prices.

Results

Carcass ultrasound was utilized to track internal and external fat deposition while steers were on test (Figures 1 – 3). There were no interactions observed for carcass ultrasound REA and RF ($P \leq 0.19$). Implant did not impact REA or RF, but both measurements did increase with days on feed. For IMF, there was an implant X marketing date interaction ($P \leq 0.02$; Figure 3). This was driven by the PLU/MKT3 steers internal fat deposition plateauing after d56 on feed. Because the PLU/MKT2 steers continued to build marbling between d56 and 84, researchers do not believe that implant was the reasoning for the marbling plateau. The PLU/MKT3 steers also had the numerically lowest ADG while on feed, which could be a factor in hindering marbling deposition.

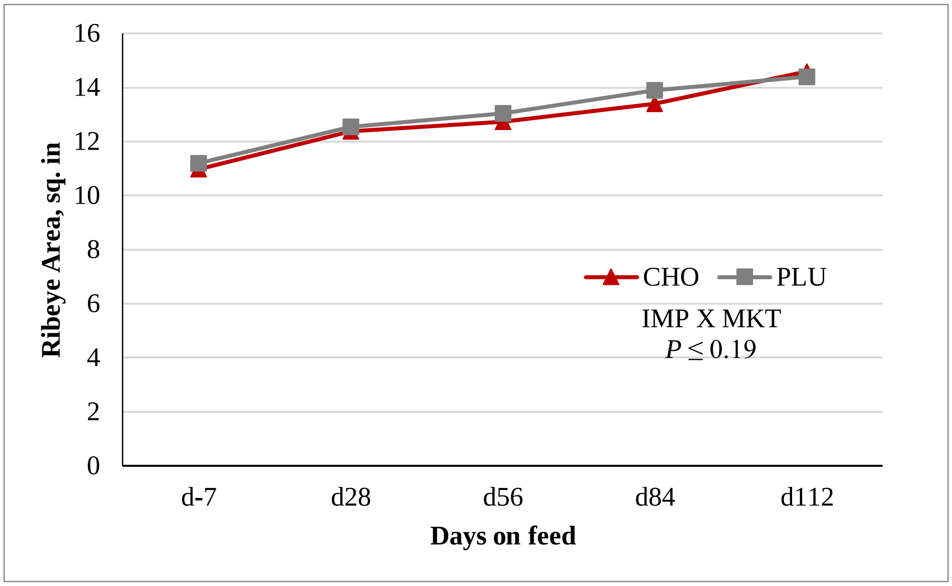

Figure 1. Impact of implant on ribeye area measured via carcass ultrasound[1]
[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); IMP = implant; MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124

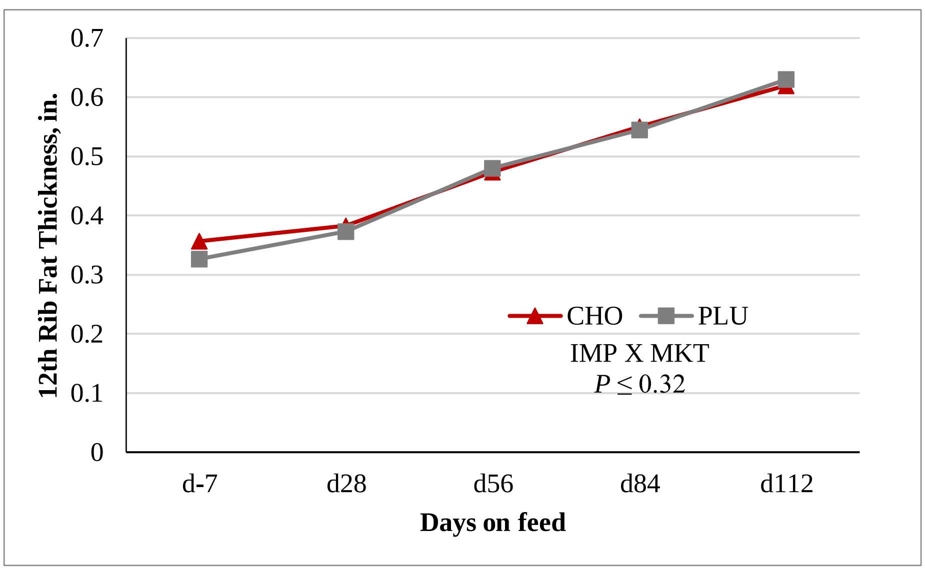

Figure 2. Impact of implant on 12th rib fat thickness measured via carcass ultrasound[1]
[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); IMP = implant; MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124

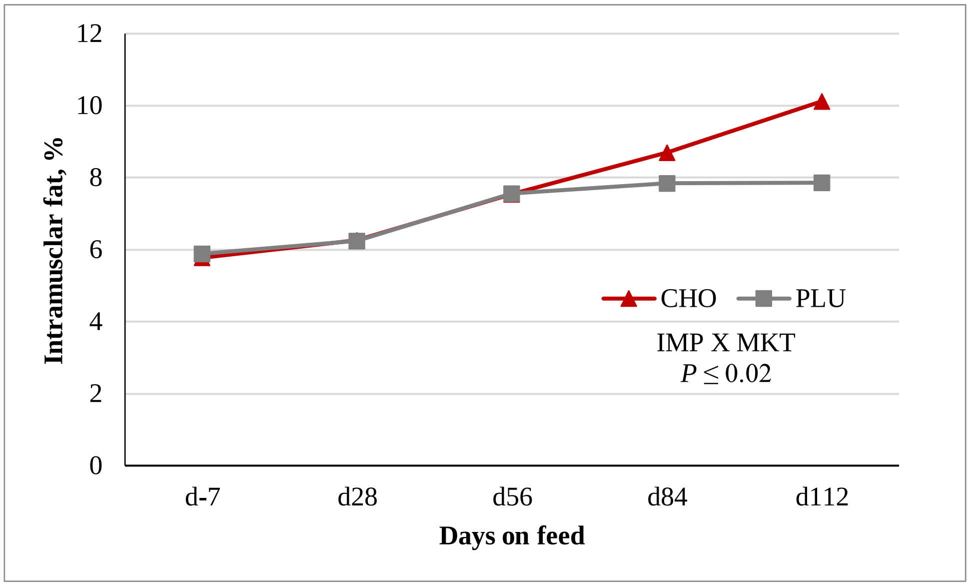

Figure 3. Impact of implant on intramuscular fat measured via carcass ultrasound[1,2]
[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); IMP = implant; MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124
[2]5.6% = average Choice; 7.0% = high Choice; 8.6% = low Prime; 10.0% = average Prime).

While on feed, marketing date X implant interactions for DMI or F:G were not observed ($P \geq 0.17$; Table 2), but there was an interaction for ADG ($P = 0.04$). The PLU/MKT1 steers had greater ADG than other market date X implant combinations. On the average, PLU-implanted steers had greater ADG ($P = 0.02$; 3.94 lbs./hd/d) than CHO-implanted steers (3.70 lbs./hd/d) which is consistent with previous research and the increasing TBA potency of the implants. Average daily gain also decreased as days on feed increased ($P = 0.01$; 4.02, 3.89, and 3.55 lbs./hd/d for MKT1, MKT2, and MKT3, respectively) which can be attributed to a combination of increasing age and weight as well as nearing implant payout. Because of the improved ADG and similar DMI, steers that received the PLU implant tended to have improved F:G ($P = 0.06$; 6.32 lbs. of feed per lb. of gain) compared to CHO-implanted steers (6.81 lbs. of feed per lb. of gain).

There was a tendency for marketing date X implant interactions ($P \leq 0.10$) to impact carcass adjusted final BW, HCW, and MS. While no interactions were observed ($P \geq 0.13$), there were linear increases in REA, RF, and YG in marketing dates ($P \leq 0.02$). These findings are consistent with ultrasound data and support the natural growth pattern of cattle getting heavier and increasing fat deposition the longer on feed. Implant treatment did not have an impact on steer MS during the first and second harvest dates; however, steers on the PLU/MKT3 treatments had significantly lower MS (702; CAB) compared to CHO/MKT3 group (800; Low Prime). This is likely reflective of poorer performance of PLU/MKT3 for unknown reasons, outside of implant response.

Table 2. Growth performance and characteristics of steers based on implant strategies and market end point[1]

	CHO IMP			PLU IMP						
	MKT1	**MKT2**	**MKT3**	**MKT1**	**MKT2**	**MKT3**	**SEM**	**MKT**	**IMP**	**MKT X IMP**
n, hd/trt	18	18	18	18	18	18				
DOF	68	96	124	68	96	124				
Growth performance										
IBW	837	812	832	834	829	813	10.8	0.58	0.93	0.48
FBW	1097	1152	1291	1114	1226	1256	14.5	<0.01	0.38	0.10
DMI	24.0	24.8	25.7	24.8	23.2	24.3	0.51	0.50	0.30	0.31
ADG	3.84^{bc}	3.64^{bc}	3.62^{c}	4.20^{a}	4.13^{ab}	3.49^{c}	0.073	0.01	0.02	0.04
F:G	6.30	6.96	7.18	6.02	5.78	7.15	0.183	0.05	0.06	0.17
Carcass characteristics										
HCW	691	726	814	702	772	791	9.1	<0.01	0.38	0.10
MS	668	745	803	673	743	702	14.8	0.01	0.12	0.08
REA	11.21	12.68	13.58	11.50	13.40	13.64	0.180	0.02	0.13	0.20
RF	0.48	0.57	0.78	0.44	0.55	0.68	0.032	<0.01	0.53	0.13
YG	2.7	3.2	3.9	2.6	3.1	3.6	0.10	<0.01	0.18	0.35

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); IMP = implant; MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; DOF = days on feed; IBW = initial body weight; FBW = carcass adjustment final body weigh calculated utilizing hot carcass weight and standard 63% dressing percentage; DMI = dry matter intake; ADG = average daily gain; F:G = feed to gain ratio; HCW = hot carcass weight; MS = marbling score (600 = average Choice; 700 = high Choice; 800 = Prime); REA = ribeye area; RF = 12th rib back fat thickness; YG = yield grade

[a-c]Means without a common superscript differ ($P < 0.05$)

All steers on the study, regardless of marketing date or implant, graded Choice or higher (Figure 4). In MKT1, 53% of the steers graded Certified Angus Beef (CAB) and 14% graded Prime (average RF thickness of 0.46 inches). For MKT2, 44% were CAB and 47% graded Prime (average RF thickness of 0.56 inches). In the final marketing group, 36% graded CAB with an additional 42% Prime (average RF thickness of 0.73 inches). Based on this data set, feeding cattle for an additional 28 days after the first harvest date resulted in an additional 33% of cattle grading Prime. However, less of an advantage was found when feeding another 28 days to the final marketing date, likely due to the poor performance of PLU/MKT3 steers.

Carcass weight distributions based on marketing date and implant can be found in Figure 5. When fed to approximately 0.50 inch of external backfat at the first harvest date, 58% of the cattle harvested were discounted for lightweight carcasses (under 699 lbs.). On the final marketing date, 15% were over a 1,000 lb. carcass, but none received a heavyweight discount from the packing plant (>1,050 lb.).

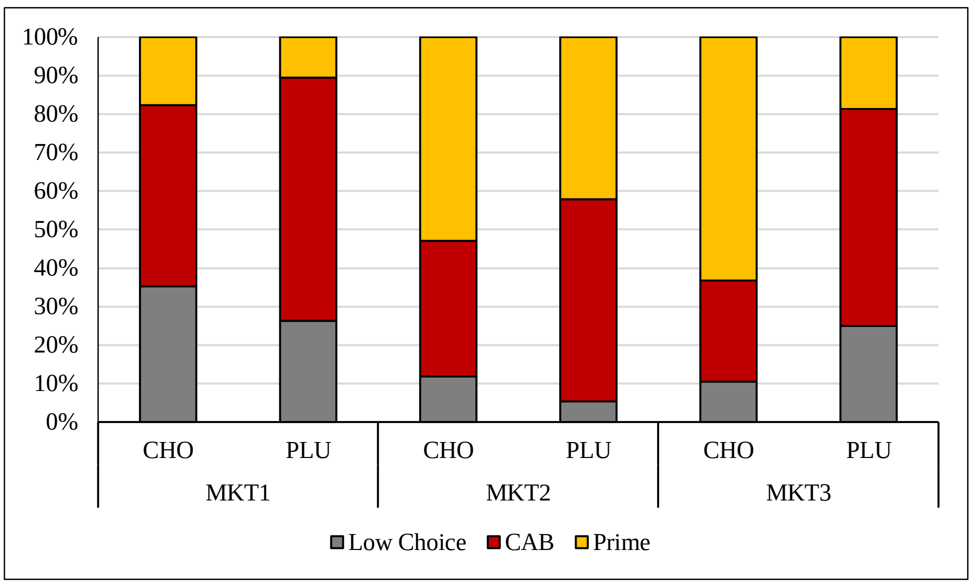

Figure 4. Quality grade distribution[1]

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; CAB = Certified Angus Beef (average or high Choice)

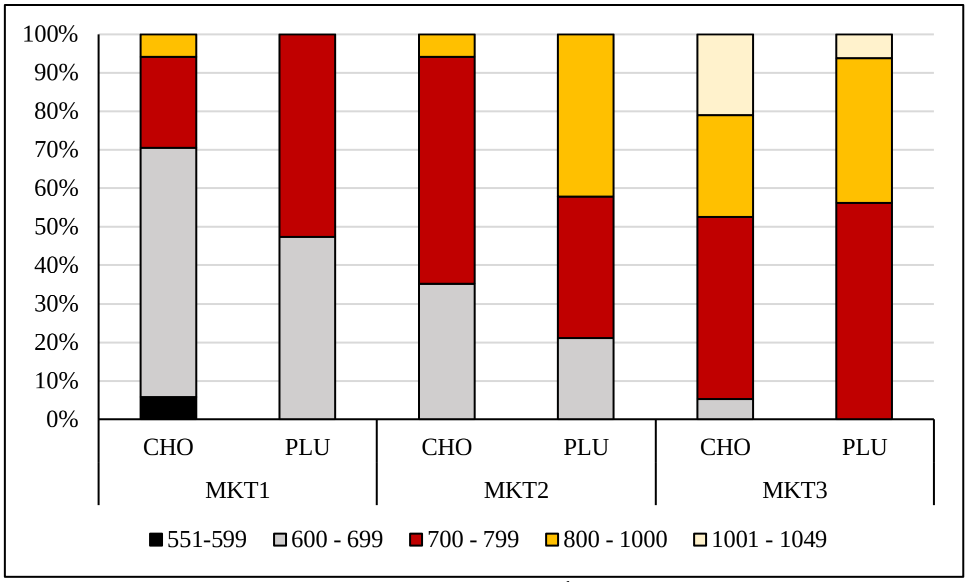

Figure 5. Hot carcass weight distribution[1]

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; CAB = Certified Angus Beef (average or high Choice)

Carcass weights and days on feed have been continually increasing in the beef industry for many years. This is incentivized by an increased dressing percentage of cattle as they increase in live weight, a trend for more cattle marketed on a grid or carcass basis, and quality premiums. Table 3 shows the economic tradeoffs related to market timing when feed costs and quality premiums vary. The feed cost per ton (dry matter basis) are estimated based off 10-year USDA prices for corn ranging from $4.50/bu – $8.50/bu. Boxes shaded represent the most economical market timing given live and carcass performance of the current study for each implant treatment group.

In the PLU treatment, the second slaughter date is optimum for all feed cost and quality premium scenarios. This is driven by the superior performance of steers assigned to this marketing date for this treatment. Also, marbling plateaued and growth performance slowed for PLU-implanted steers between the second and third market dates for unidentified reasons. In the CHO treatment, the cattle growth performance, weight, and carcass quality improved with days on feed. When using lower and average quality grade premiums, the optimum market date was the last market date when feed prices were at or below $300/T of DM. At higher feed prices, it was more economical to market the cattle at an interim weight. When quality premiums were high with CHO-implanted steers, returns were greatest when the cattle were marketed in the last marking date regardless of the feed cost. It should be noted that over $100 in premiums were added to this group when the lowest and highest quality premiums are compared.

Table 3. Returns per head of steers at various market timings at given feed costs and carcass quality premiums[1, 2]

	CHO Implant			PLU Implant		
	MKT1	**MKT2**	**MKT3**	**MKT1**	**MKT2**	**MKT3**
Low quality premiums ($2 CAB and $5 Prime)						
Feed cost $200/T DM	$ (11.90)	$ 64.30	$ 121.99	$ 39.41	$ 161.54	$ 120.72
Feed cost $250/T DM	$ (53.01)	$ 5.14	$ 39.60	$ (2.73)	$ 104.18	$ 41.53
Feed cost $300/T DM	$ (94.11)	$ (54.02)	$ (42.79)	$ (44.87)	$ 46.81	$ (37.65)
Feed cost $350/T DM	$(135.22)	$(113.18)	$(125.18)	$ (87.01)	$ 10.56)	$(116.84)
Feed cost $400/T DM	$(176.33)	$(172.34)	$(207.57)	$(129.15)	$ (67.92)	$(196.03)
Average quality premiums ($5 CAB and $15 Prime)						
Feed cost $200/T DM	$ 10.04	$ 110.75	$ 178.16	$ 59.46	$ 205.70	$ 148.40
Feed cost $250/T DM	$ (31.07)	$ 51.59	$ 95.77	$ 17.32	$ 148.34	$ 69.22
Feed cost $300/T DM	$ (72.18)	$ (7.57)	$ 13.38	$ (24.82)	$ 90.97	$ (9.97)
Feed cost $350/T DM	$(113.28)	$ (66.73)	$ (69.01)	$ (66.96)	$ 33.60	$ (89.15)
Feed cost $400/T DM	$(154.39)	$(125.89)	$(151.40)	$(109.10)	$ (23.76)	$(168.34)
High quality premiums ($8 CAB and $25 Prime)						
Feed cost $200/T DM	$ 31.98	$ 157.20	$ 234.32	$ 79.50	$ 249.86	$ 176.09
Feed cost $250/T DM	$ (9.13)	$ 98.04	$ 151.93	$ 37.36	$ 192.49	$ 96.90
Feed cost $300/T DM	$ (50.24)	$ 38.88	$ 69.54	$ (4.78)	$ 135.13	$ 17.72
Feed cost $350/T DM	$ (91.34)	$ (20.28)	$ (12.85)	$ (46.92)	$ 77.76	$ (61.47)
Feed cost $400/T DM	$(132.45)	$ (79.44)	$ (95.24)	$ (89.06)	$ 20.39	$ (140.66)

[1]Abbreviatons: CHO = Synovex Choice (100 mg of TBA); PLU = Synovex Plus (200 mg of TBA); MKT1 = first harvest date on d68; MKT2 = second harvest date on d96; MKT3 = third harvest date on d124; CAB = Certified Angus Beef (average or high Choice); DM = dry matter
[2]Shaded cells represent the most economical market timing given live and carcass performance of the current study for each implant treatment group

c. Conclusions

Genetics for carcass grading improves each year resulting in more Prime and upper Choice carcasses. Even with the greater supply, consumer demand and grid premiums for high quality beef remains strong. To maximize carcass quality, cattle are often fed longer at the expense of reduced performance and higher cost of gain. This study was designed to evaluate the tradeoffs related to days on feed and market timing contingent on feed costs and grid premiums and discounts for high quality cattle sold on a carcass or grid market basis.

Results from this study demonstrate that implant potency can improve live animal growth performance with minimal negative side effects of carcass quality. Using the growth and carcass performance of steers on trial, with low to average feed prices ($100 - $300/ton, dry matter basis), the optimum market date was the last market date regardless of quality grade premiums. At higher feed prices, it was more economical to market the cattle at an interim weight.

d. Unexpected Problems or Outcomes

The first marketing date was determined based off ultrasound RF data targeting 0.50 inch of back fat. Previous research has shown a strong correlation between ultrasound data and actual kill data; however, ultrasound data tends to be slightly higher estimates of RF compared to RF measurements at the packing plant due to frequent removal of some fat when the hide is pulled off the carcass. Growth performance of steers this year were slighter lower than herd mates in years' prior, so steers marketed in the second and third group were lighter than originally planned.

Following the economy trends, the cost of carcass ultrasound interpretation increased from the time the proposal was submitted to when the study began. While that expense was greater than anticipated, the study was under total budget.

e. Completed and Planned Publications, Presentations, and Outreach Media

Data was originally planned to be shared at 2023 Iowa Beef Center Cattle Feeders Camp to be held on November 30th and December 1st at the ISU Armstrong Research Farm. However, the meeting was canceled due to low registrations. Researchers now plan to share the data at the 2024 Iowa Beef Center Feedlot Short Course (date TBD).

An ISU Animal Industry Report and ISU Armstrong Research Farm Report will be generated utilizing the data. In addition, at least one article will be written for beef extension teams' monthly newsletter, *Growing Beef*. Articles from the newsletter are frequently picked up by other popular press media outlets includes FEED-LOT Magazine, Drovers, and BEEF Magazine.

f. Personnel Support

Erika Lundy-Woolfolk committed 0.03 FTE of her time on the project ($2,867).

Garland Dahlke committed 0.01 FTE of his time on the project ($1,292).

Beth Reynolds committed 0.01 FTE of her time on the project ($819).

g. Budget

	Budgeted	Spent	Remaining
Employee salary & benefits	$ 5,258	$ 4,978	$ 280
Travel	$ 1,867	$ 1,799	$ 68
Equipment	$ 2,000	$ 1,970	$ 30
Supplies & materials	$ 2,000	$ 1,123	$ 877
Other	$ 7,738	$ 7,397	$ 341
Total	$18,863	$17,267	$ 1,596