PEER REVIEWED

Effect of Viral Respiratory Vaccine Treatment on Performance, Health and Carcass Traits of Auction-origin Feeder Steers

T.C. Bryant[1], *PhD;* **K.C. Rogers**[2], *DVM, MS;* **N.D. Stone**[3], *BS;* **D.G. Miles**[2], *DVM, MS*
[1]*Manager of Beef Programs, Operations Analysis, and Research, Five Rivers Cattle Feeding, Loveland, CO 80538*
[2]*Veterinary Research and Consulting Services, Greeley, CO 80634*
[3]*General Manager, Kuner Feedlot, Kersey, CO 80644*

Abstract

A total of 3,147 auction-origin steers were used to compare the effects of three different virus vaccines on performance, health, carcass traits and economic return in a commercial feedlot. Vaccine products compared were Pyramid® 5 (Fort Dodge Animal Health, Overland Park, KS), Bovi-Shield Gold® 5 (Pfizer Animal Health, New York, NY) and Bovi-Shield Gold® IBR-BVD. Steers vaccinated with Pyramid 5 (PYR5) vaccine had 3.8% (P=0.09) better feed conversion than those vaccinated with Bovi-Shield Gold IBR-BVD (BOV3) vaccine when calculated on a live-weight basis, but similar to steers in the Bovi-Shield Gold® 5 (BOV5) group. On a carcass-weight basis, feed conversion was 3.6% better (P=0.09) in the PYR5 treatment group compared to steers in the other treatment groups. No differences (P>0.10) in carcass traits were noted among the three treatment groups. The morbidity rate due to bovine respiratory disease was 11% lower (P=0.09) in steers vaccinated with PYR5 compared to those vaccinated with BOV5, and the relapse rate was 22% lower (P=0.04). Combined treatment and railer (culling) costs were $8.81/head and $7.56/head lower in the PYR5 group than in the BOV5 and BOV3 steers, respectively. Mortality costs did not differ among treatments (P=0.52).

Keywords: bovine, BRD, virus, vaccine, vaccination

Résumé

Un total de 3147 bouvillons d'encan ont été utilisés pour comparer l'effet de trois vaccins viraux sur la performance, la santé, les caractéristiques de carcasse et les retombées économiques dans un parc d'engraissement. Les trois vaccins étaient les suivants : Pyramid 5 (Fort Dodge Animal Health, Overland Park, KS), Bovi-Shield Gold 5 (Pfizer Animal Health, New York, NY) et Bovi-Shield Gold IBR-BVD. Il y avait une hausse de 3.8% de la conversion alimentaire (P = 0.09) chez les bouvillons vaccinés avec Pyramid 5 (PYR5) par rapport à ceux vaccinés avec Bovi-Shield Gold IBR-BVD (BOV3) lorsque la conversion était calculée sur la base du poids vif. La conversion basée sur le poids vif ne variait pas entre les bouvillons du groupe PYR5 et ceux du groupe Bovi-Shield Gold 5 (BOV5). Il y avait une hausse de 3.6% (P = 0.09) de la conversion, basée sur le poids de la carcasse, chez les bouvillons vaccinés avec PYR5 plutôt qu'avec les deux autres vaccins. Il n'y avait pas de différence (P>0.10) au niveau des caractéristiques de carcasse entre les trois groupes vaccinés. Il y avait une baisse de 11% du taux de morbidité (P = 0.09) causée par les maladies respiratoires bovines chez les bouvillons vaccinés avec PYR5 par rapport à ceux vaccinés avec BOV5 et le taux de rechute était 22% moins élevé (P=0.04). Par rapport au groupe PYR5, les coûts de traitement et de réforme étaient plus élevés de 8.81$ par tête dans le traitement BOV5 et de 7.56$ par tête dans le groupe BOV3. Les coûts associés à la mortalité ne variaient pas selon le type de vaccin (P=0.52).

Introduction

Many respiratory viral vaccines are available for the prevention of bovine respiratory disease (BRD). Each vaccine has unique characteristics such as antigen content, virus strain(s) and presence or absence of adjuvant. In a previous study it was more cost-effective to vaccinate auction-market derived, fall-placed feedlot calves with a multivalent viral vaccine containing infectious bovine rhinotracheitis (IBR) virus, parainfluenza 3 (PI_3) virus, bovine viral diarrhea (BVD) virus and bovine respiratory syncytial (BRS) virus compared to a univalent viral vaccine containing IBR virus only.[2] In another study, feedlot health parameters and some production costs were improved for feeder cattle vaccinated with

BRS virus utilizing an adjuvanted modified-live antigen.[1] The purpose of this study was to compare the effects of three different initial respiratory viral vaccines on performance, health and carcass quality of auction-market derived steers fed in a commercial feedlot setting.

Materials and Methods

Cattle

A total of 3,147 feeder steers were allocated to 10 blocks of three pens each (30 pens total) to compare the effects of initial respiratory vaccine on performance, health and carcass characteristics of lightweight, auction-derived feeder steers in a commercial feedlot setting. Cattle were purchased at auction markets in Colorado, Idaho, Nebraska, Oregon, South Dakota, Utah and Wyoming, and delivered to Kuner Feedlot in Kersey, Colorado from September 22 to October 31, 2005. Cattle were English-Continental breed crosses, and to qualify for inclusion in the trial, groups had to have purchase weights between 500 and 650 lb (227 to 295 kg). Cattle that met the qualifications were allocated to one of three vaccine treatment groups. Each pen within a replicate had similar background, age and average animal weight. Across all pens, arrival weights averaged 512 to 609 lb (233 to 277 kg).

Treatment Assignment

Upon arrival to the feedlot, steers remained separated by truckload and source and were placed in receiving pens. Vaccine treatment and pen assignments were predetermined by randomly drawing treatment group order out of a hat. The first treatment group selected was assigned the lowest lot and pen number. Allotment to the treatment group occurred within each truckload. All truckload lots required to fill a block were received at approximately the same time (maximum seven-day duration). Within a truckload lot, calves were of similar age, background, health status, weight and breed type. Allocation of animals to a processing group occurred by sorting cattle within each truckload in a feedlot sorting alley three at a time (3x3x3) into one of the three treatments (three pens per block), which allowed animals to be penned by treatment (10 pens/treatment). Subsequent to allocation to treatment, cattle were weighed as a group within truckload by treatment on a ground scale.

All cattle within replicate were placed in adjacent pens, and the same pen rider(s) was used across treatments to minimize bias. Pen riders and treatment technicians were masked to treatment. Cattle were provided approximately 200 ft^2 per head of pen space, and 12 inches (30 cm) of bunk space per head.

A diagnosis of BRD was made when a calf showed clinical signs of depression (e.g., inattentive to activity in the pen, lowered head and drooped ears, inappetance), absence of clinical signs attributable to other body systems, and a rectal temperature ≥104°F (40.0°C). BRD-associated relapses were defined as steers treated two or more times for BRD, regardless of location in the feedlot. An animal that relapsed was only counted once.

Processing

Hay and water were offered *ad libitum* at arrival, and cattle were generally processed within 36 hours of arrival. Processing included:

- Serially-numbered lot ear tag
- Color-coded ear tag corresponding to the replicate. The date the cattle were processed was written on this tag.
- Respective modified-live virus trial vaccine: PYR5[a] (IBR virus, BVD virus types 1 and 2, PI_3 virus and BRS virus combination); BOV5[b] (IBR virus, BVD virus types 1 and 2, PI_3 virus and BRS virus combination); or BOV3[c] (IBR virus, BVD virus types 1 and 2 combination), 2 mL IM in the left neck
- *Mannheimia haemolytica* toxoid[d] (2 mL subcutaneously [SC] in the right neck)
- Tilmicosin[e] (1.5 mL/100 lb bodyweight SC in the right neck)
- Ivermectin[f] (1 mL/220 lb bodyweight SC in the left neck)

Steers were administered a combination 100 mg progesterone – 10 mg estradiol benzoate[g] implant at approximately 45 days-on-feed, and a 120 mg trenbolone acetate – 24 mg estradiol[h] terminal implant at 107 days-on-feed (range 76 to 126 days). All cattle were revaccinated with a modified-live IBR-BVD (types 1 and 2) vaccine[i] when they were reimplanted. Cattle in three replicates (9, 10 and 11) were also revaccinated prior to receiving their terminal implant because of increased morbidity and mortality.

Cattle in replicate two were removed from the trial because a defective syringe was used to administer the anthelmintic, resulting in an incorrect or unknown dosage. To compensate, an additional replicate (11) was added to the trial to complete the 10 blocks.

An ear-notch skin sample was collected from all animals that died or that were classified as railers. Ear-notch samples were tested for persistently-infected (PI) BVD infection using the immunohistochemistry test (IHC).

Gender was determined, and those found to be bulls were individually weighed and castration was delayed until the health status was more optimal. Castration was performed via banding when possible; calves requiring surgical castration were left intact. *Clostridium perfringens* types C&D–*tetani* bacterin–

toxoid[j] was administered to bull calves that were banded. Effort was made to equalize the number of bulls across replicates and treatments during the initial processing. A total of 55 bulls were placed on the trial (PYR5, 21 bulls; BOV5, 18 bulls; BOV3, 16 bulls).

Animals sold early (culled) because of unsatisfactory response to treatment for BRD or other problems were classified as railers. All cattle that died were necropsied by one of the authors (KCR) or her trained assistant.

Feed

Cattle were fed two times daily, and diet and bunk management strategies were similar for all pens within a replicate. Feed amounts were recorded for each pen on a daily basis, and dry matter content of the ration was analyzed weekly. Monensin[k] and tylosin[l] were fed for the entire feeding period, and ractopamine[m] was fed for approximately the last 28 days of the feeding period for all pens within replicates 3, 5, 7, 10 and 11.

Marketing and Economics

Pens within each replicate were marketed at constant days-on-feed according to visual evaluation of body fat and feed intake patterns routinely used by the feedyard. Pens within each replicate were managed similarly during final weighing, shipment and harvest; shipment order (pens within replicate) was randomized. All steers were harvested at a commercial packing plant in Greeley, CO from May 12 to June 21, 2006, and routine pen-carcass data were collected for all cattle.

All economic data were standardized to common market conditions: \$110/100 lb (45.4 kg) bodyweight (BW) equivalent feeder steer price with a \$5/100 lb BW slide, e.g., the initial feeder calf price was adjusted by \$5/100 lb BW for each 100 lb above or below a 750 lb (341 kg) reference BW; \$54/100 lb BW railer salvage value price; and current treatment costs, which were calculated based on actual cost. Railer (cull) cost was determined as the net economic loss of a railed animal by subtracting the salvage value of the railed animal from the initial cost. The salvage value was calculated as \$54/100 lb BW multiplied by the average in-weight. Railer cost for each treatment was calculated as initial animal cost minus salvage value multiplied by the percent of animals that were railed. Dead costs were calculated as the value of an animal at arrival (standardized market value of \$110/100 lb BW with a \$5/100 lb slide to a 750-lb equivalent weight) multiplied by the percentage of steers in each treatment that died.

Statistical Analyses

All performance data (i.e. continuous variables) were analyzed using PROC MIXED procedure of SAS[n] as a randomized complete block design with pen as the experimental unit. For all categorical data such as morbidity, mortality and carcass parameters, head counts (events) within each pen for each parameter were totaled and were subsequently analyzed using the events/trials syntax of PROC GLIMMIX procedure of SAS as a randomized complete block design, with pen as the experimental unit. For all analyses, replicate and treatment were included in the model as class variables. Treatment was considered as a fixed effect, and replicate was considered a random effect.

Results and Discussion

Performance data are shown in Table 1. Initial weight of steers did not differ among treatments, averaging 583 lb (265 kg). Cattle were fed for 234 days. Dry matter intake and average daily gain did not differ ($P>0.10$) among treatments, and there were no differences ($P>0.10$) in final weight on a live-weight or carcass-weight basis. Steers vaccinated with PYR5 vaccine had 3.8% better ($P=0.09$) feed conversion than those vaccinated with BOV3 vaccine when calculated on a live-weight basis, but similar to steers in the BOV5 group. On a carcass-weight basis, feed conversion was 3.6% better ($P=0.09$) in the PYR5 treatment group compared to steers in the other groups. Carcass traits were similar ($P>0.10$) among treatment groups (Table 2).

Average rectal temperature when cattle were first treated for BRD was 105°F (40.6°C) in all treatment groups (Table 3). The morbidity rate due to BRD was lower ($P=0.09$) in calves vaccinated at arrival with PYR5 compared to those vaccinated with BOV5, but similar to calves vaccinated with BOV3. The cumulative morbidity rate across days-on-feed is shown in Figure 1. BRD-associated relapse rate (Table 3) was significantly lower ($P=0.04$) in steers vaccinated with PYR5 compared to those vaccinated with BOV5 or BOV3—14.92 vs 19.09 and 18.53%, respectively. The death rate due to BRD was similar ($P=0.31$) across treatment groups.

Necrotic tracheitis was diagnosed at necropsy in 21 steers; six steers were vaccinated with PYR5, seven with BOV5 and eight with BOV3. The lesions were compatible with IBR, which was confirmed by fluorescent antibody staining and virus isolation from five samples sent to the Colorado State University Diagnostic Laboratory. IBR was an unexpected finding as all cattle were vaccinated against this disease at arrival processing, and all products used were modified-live virus vaccines licensed by the US Department of Agriculture. Nevertheless, cattle developed IBR in all three vaccine groups. Steers identified with necrotic tracheitis died between 71 and 101 days-on-feed, which corresponded

Table 1. Feeding performance of feedlot steers vaccinated at arrival with different modified-live virus vaccines (LS means).

Item	PYR5[c]	BOV5[d]	BOV3[e]	SE	*P*-value
No. pens	10	10	10		
No. steers received	1,047	1,050	1,050		
No. steers shipped	982	964	956		
Initial weight[f], lb	583	581	584	7.65	0.64
Final weight, lb					
Live-weight basis[g]	1289	1286	1291	12.85	0.69
Carcass-weight basis[h]	1287	1277	1287	5.89	0.19
Days-on-feed	234	234	234	0.00	1.00
DMI, lb/day	15.7	15.6	15.7	0.14	0.56
Average daily gain[i], lb					
Live-weight basis[j]	2.83	2.76	2.74	0.05	0.20
Carcass-weight basis[h]	2.82	2.73	2.73	0.05	0.15
Feed:Gain[i],					
Live-weight basis[j]	5.54[a]	5.66[ab]	5.76[b]	0.10	0.09
Carcass-weight basis[h]	5.56[a]	5.74[b]	5.79[b]	0.10	0.09

[a,b]Means in the same row with different superscripts differ ($P<0.10$)
[c]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[d]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[e]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY
[f]Weight at feedyard
[g]Shrunk (4%) weight at feedyard of cattle that were harvested
[h]Adjusted to 64.0% dressing percent
[i]Deads-in
[j]Based on unshrunk initial weights and shrunk final weights

Table 2. A comparison of carcass traits in feedlot steers vaccinated at arrival with different modified-live virus vaccines (LS means).

Item	PYR5[a]	BOV5[b]	BOV3[c]	SE	*P*-value
Hot carcass weight, lb	823	817	824	7.9	0.19
Dressing[d], %	63.88	63.57	63.80	0.19	0.14
Prime, %	0.35	0.35	0.36		1.00
Choice, %	40.84	37.77	41.22		0.27
Standard, %	3.93	5.42	4.74		0.30
Commercial, %	0.10	0.31	0.21		0.63
Yield Grade 1, %	6.61	6.91	7.19		0.88
Yield Grade 2, %	39.80	40.25	41.60		0.71
Yield Grade 4, %	8.09	6.47	7.46		0.40
Yield Grade 5, %	0.61	0.83	0.83		0.81

[a]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[b]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[c]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY
[d]Based on shrunk final weight at feedyard

with the second elevation in BRD-related morbidity and mortality illustrated in Figures 1 and 2.

No difference in non-respiratory morbidity (P=0.30) or total mortality (P=0.19) was noted among treatments. The railer rate due to BRD was lower (P=0.06) in steers vaccinated with PYR5 at arrival processing than in steers administered the other two vaccines. Total railer rate did not differ (P=0.37).

Four steers that died or railed were found to be persistently infected with BVDV using IHC. There was one positive steer in each of the PYR5 and BOV5 treatment groups, and two in BOV3 steers. Three PI animals were railed, and one died. The prevalence of PI in calves that died or were railed was 1.7%, but the sampling/testing protocol precluded determination of prevalence in the total population.

A comparison of economic outcomes for the three treatment groups is shown in Table 4. When comparing costs associated with treatment, railer cost and treatment plus railer cost, costs were significantly lower in

Table 3. Health performance of feedlot steers vaccinated at arrival with different modified-live virus vaccines (LS means).

Item	PYR5[c]	BOV5[d]	BOV3[e]	SE	*P*-value
Temperature at first pull, °F	105.0	105.0	105.0	0.05	0.65
BRD morbidity[f], %	40.83[a]	45.83[b]	44.17[ab]		0.09
Relapse[g], %	14.92[a]	19.09[b]	18.53[b]		0.04
Non-BRD morbidity, %	2.76	3.67	2.57		0.30
Mortality-BRD, %	3.08	3.95	4.31		0.31
Mortality-all causes, %	4.51	5.88	6.34		0.19
Railer-BRD, %	0.47[a]	1.59[b]	1.59[b]		0.06
Railer-all causes, %	1.50	2.16	2.34		0.37

[a,b]Means in the same row with different superscripts differ (P<0.10)
[c]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[d]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[e]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY
[f]Cattle that were pulled and treated for the first time for BRD-related diagnosis
[g]Cattle that were pulled-and treated again for a BRD-related disease, regardless of location in the feedlot. An animal that relapsed more than one time was only counted once.

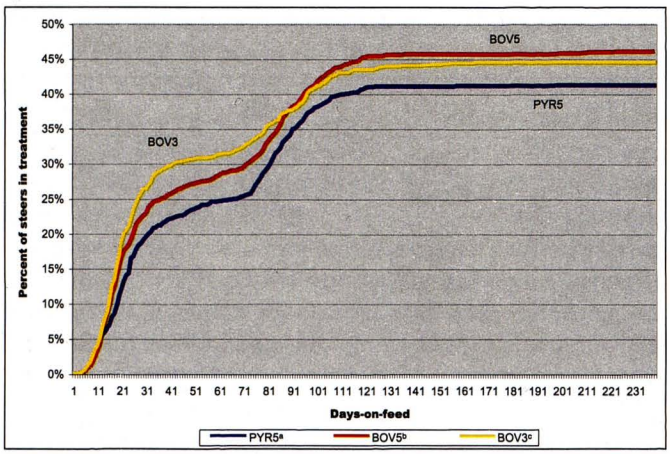

Figure 1. Cumulative morbidity rates due to BRD in feedlot steers vaccinated at arrival with different modified-live virus vaccines.

[a]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[b]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[c]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY

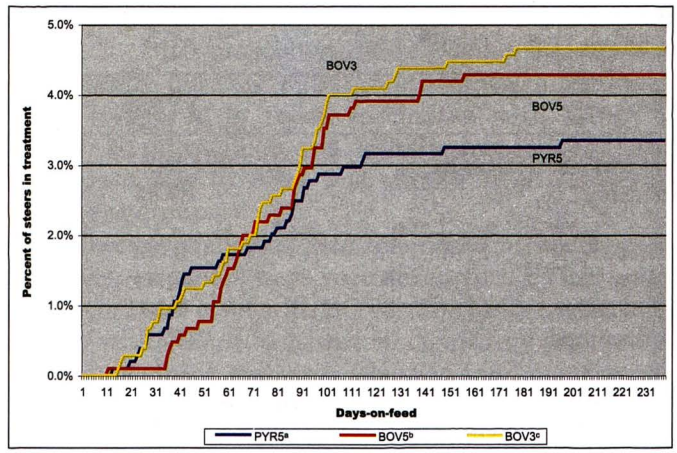

Figure 2. Cumulative mortality rates due to BRD in feedlot steers vaccinated at arrival with different modified-live virus vaccines.

[a]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[b]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[c]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY

Table 4. Economic outcome of feedlot steers vaccinated at arrival with different modified-live virus vaccines[f] (LS means).

Item	PYR5[c]	BOV5[d]	BOV3[e]	SE	*P*-value
Treatment costs[g], $/hd	$8.09[a]	$11.88[b]	$10.88[b]	1.88	0.02
Railer costs[h], $/hd	$2.25[a]	$7.27[b]	$7.02[b]	1.52	0.03
Treatment + railer costs, $/hd	$10.34[a]	$19.15[b]	$17.90[b]	2.52	0.005
Mortality costs[i], $/hd	$23.56	$30.24	$31.63	6.46	0.52
All costs, $/hd	$33.91	$49.39	$49.53	8.15	0.15

[a,b]Means in the same row with different superscripts differ ($P<0.10$)
[c]Pyramid 5, Fort Dodge Animal Health, Overland Park, KS
[d]Bovi-Shield Gold 5, Pfizer Animal Health, New York, NY
[e]Bovi-Shield Gold IBR-BVD, Pfizer Animal Health, New York, NY
[f]All costs associated with initial BRD ailments, and all values are calculated as a per-head basis across the entire lot
[g]Only includes medicine costs and does not include a chute charge
[h]Calculated as the net cost from the initial animal cost minus the potential salvage value multiplied by the percent that were railed
[i]Calculated as the initial cost of the animals multiplied by the percent that died

steers vaccinated with PYR5 at arrival processing than in steers in the other treatment groups (P=0.02, 0.03 and 0.005, respectively). Combined, PYR5 cattle had $8.81/head and $7.56/head lower treatment and railer costs than the BOV5 and BOV3 treatments, respectively. Mortality costs and all-costs did not differ among treatment groups (P=0.52 and 0.15, respectively).

Conclusions

Under the conditions of this study, there were no differences between BOV5 and BOV3 in performance, carcass traits, health parameters or economic outcomes measured. Steers vaccinated at arrival with PYR5 had improved feed conversion, lower morbidity and relapse rates due to BRD, and lower BRD-associated railer rates, hence a significant economic advantage in treatment and railer costs.

Endnotes

[a]Pyramid® 5, Fort Dodge Animal Health, Overland Park, KS
[b]Bovi-Shield Gold® 5, Pfizer Animal Health, New York, NY
[c]Bovi-Shield Gold® IBR-BVD, Pfizer Animal Health, New York, NY
[d]Presponse® SQ, Fort Dodge Animal Health, Overland Park, KS
[e]Micotil®, Elanco Animal Health, Indianapolis, IN
[f]Promectin, Phoenix Scientific, St. Joseph, MO
[g]Synovex® C, Fort Dodge Animal Health, Overland Park, KS
[h]Component® TE-S, VetLife, West Des Moines, IA
[i]Titanium® 3, Agrilabs, St. Joseph, MO
[j]Vision® CDT, Intervet Inc, Millsboro, DE
[k]Rumensin®, Elanco Animal Health, Indianapolis, IN
[l]Tylan®, Elanco Animal Health, Indianapolis, IN
[m]Optaflexx®, Elanco Animal Health, Indianapolis, IN
[n]SAS Institute Inc, Cary, NC, USA, Software Version 8

Acknowledgement

Funding for this study was provided by Fort Dodge Animal Health.

References

1. MacGregor S, Wray MI: The effect of bovine respiratory syncytial virus vaccination on health, feedlot performance and carcass characteristics of feeder cattle. *Bov Pract* 38(2):162-170, 2004.
2. Schunicht OC, Booker CW, Jim GK, Guichon PT, Wildman BK, Hill BW: Comparison of a multivalent viral vaccine program versus a univalent viral vaccine program on animal health, feedlot performance, and carcass characteristics of feedlot calves. *Can Vet J* 44:43-50, 2003.