The effect of arrival vaccine combination on performance and efficiency during the receiving and backgrounding phase.

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Abstract:

A 56-day backgrounding trial was conducted to assess the impacts of three different arrival vaccine combinations on growth performance and efficiency during the receiving and backgrounding period. Crossbred high-risk heifer calves (n=393; initial BW= 499 ± 38 lb) were blocked by truck load (4) and stratified by initial BW within block and allocated into 1 of 9 pens. Pen was randomly assigned to 1 of 3 treatments to provide a total of 12 replicates per treatment for a total of 36 pens. All calves were fed a common diet composed of 40.00% Sweet Bran (Cargill Animal Nutrition, Blair, NE), 30.01% warm-season grass hay, 24.37% dry-rolled corn, and 5.63% pellet supplement. This ration was formulated to provide 53 Mcal net energy for gain (NE_g) and offered at *ad libitum* intake. Feed bunks were read at 0700h each day and were targeted to be empty when feed was delivered at 0800h. Vaccine treatment combinations were designed to include a 5-way MLV, 7-way clostridial, and respiratory and somnus bacterins. Treatments were as follows: **(Pyramid);** Pyramid 5 + Presponse SQ (Boehringer Ingelheim, Ridgefield, CT) and Bovilis Vision 7 Somnus with Spur (Merck Animal Health, Rahway, NJ)**, (Stimulator);** Stimulator 5 (Bimeda, Schaumburg, IL), Pro-Bac 4 (Bimeda, Schaumburg, IL), and Bovilis Vision 7 with Spur (Merck Animal Health, Rahway, NJ), **(Bovi-Shield Gold);** Bovi-Shield Gold One Shot (Zoetis Inc., Parsippany, NJ) and Bovilis Vision 7 Somnus with Spur. All employees responsible for the care and feeding of the animals as well as data analysis were blinded to treatments until all analyses were complete. At the conclusion of the 56-d study, final body weights, average daily gains, feed efficiency, and water usage did not differ ($P \geq 0.35$) between treatments. No differences ($P \geq 0.10$) in morbidity or mortality across treatments were detected. Arrival vaccine combinations did not affect cattle's ability to perform or interfere with their health outcomes during the early feeding period.

Introduction:

Newly received cattle face many challenges upon arrival at feedyards or backgrounding facilities. Stressors such as weaning, transportation, diet change, and pathogen exposure are just a few of the changes happening in the transition period from dam to a confined setting. The purpose of a vaccine is to provide future protection from pathogens that an animal may be subject to. Oftentimes, cattle are in a high-stress state prior to or during administration of the vaccines, which can affect the animal's ability to mount a strong immune response to those antigens. Other factors such as adjuvant type or number of injections, specifically related to endotoxin staking (the administration of multiple gram-negative bacteria containing vaccine at one time) can also play a role in the animal's ability to mount a response, as well as their propensity to get up on feed during the receiving period. Regarding adjuvant type: aluminum salts, oil-based emulsion, saponins, or monophosphoryl lipid A would be considered some of the most common adjuvant types used, although they differ in terms of modes of action, they all work to help stimulate an immune response to the antigens present in the vaccine. As to the number of injections during a processing event, this can vary depending on the operation, veterinary recommendation, and potential for disease exposure. Oftentimes, 2 or more gram-negative vaccines are given in a production setting on top of other injections such as modified

live virus vaccines, antibiotics, and injectable dewormers (Richeson et al., 2019). Endotoxins are produced from gram-negative bacteria that die and break down in the system and excessive amounts of endotoxin in the body can be fatal. Higher endotoxin levels have been known to cause "vaccine sweat" post-vaccination. This can also lead to cattle taking longer to get up on feed and appear to show more clinical illness signs post-vaccination. Given the vast array of options for vaccination protocol combinations, the objective of this study was to evaluate a direct comparison of various product lines on their impact on feed intake early in the feeding period.

Keywords: Combination vaccine, growth performance, newly-receiving calves

Experimental Procedures:

A total of 393 crossbred heifer calves (BW= 499 ± 38 lb) were purchased at auction markets in Tennessee, assembled at an order buyer's facility in Dickson, TN then shipped 674 miles to the Kansas State University Beef Stocker Unit over a 9-d period from October 9th to October 17th, 2024. The heifers were used in a randomized complete block design to analyze the effect of arrival vaccine combination on performance and efficiency during a 56-d receiving trial. Heifer calves were labeled high-risk due to long transportation time and comingling at the order buyer facility. Heifers were blocked by truck load (4), stratified by individual arrival (d -1) weight within load, and assigned to pens containing 10 or 11 head. Pens within each block were randomly assigned to 1 of 3 treatments which equaled 12 pens/treatment for a total of 36 pens. Cattle were weighed immediately on arrival (d -1) and individually identified with a visual and electronic identification tag. Heifers were then offered warm-season grass hay at 1% of BW [dry matter (DM) basis], had *ad libitum* access to water, and were allowed to rest for 24 hours.

The following day (d 0) all heifers were individually weighed again and received antibiotic metaphylaxis with Tulathromycin (Macrosyn; Bimeda, Schaumburg, IL). Heifers were treated for internal and external parasites with a combination deworming strategy using levamisole oral suspension (Levamed; Bimeda, Schaumburg, IL) and ivermectin pour-on (Bimectin; Bimeda, Schaumburg, IL), and assigned a tag with a pen number. Farm staff was blinded to vaccine treatments during the entire 56-d receiving period. Prior to trial start date, vaccine protocols were relabeled with a color and letter (**White A, Red B, and Blue C**) for the purpose of animal allocation and vaccine administration during processing and data analysis. Vaccination treatments were as follows: **White A (Pyramid);** Pyramid 5 + Presponse SQ (Boehringer Ingelheim, Ridgefield, CT) and Bovilis Vision 7 Somnus with Spur (Merck Animal Health, Rahway, NJ) **Red B (Stimulator);** Stimulator 5 (Bimeda, Schaumburg, IL), Pro-Bac 4 (Bimeda, Schaumburg, IL), and Bovilis Vision 7 with Spur (Merck Animal Health, Rahway, NJ), **Blue C (Bovi-Shield Gold);** Bovi-Shield Gold One Shot (Zoetis Inc., Parsippany, NJ) and Bovilis Vision 7 Somnus with Spur. Throughout the trial, heifers were observed twice daily for clinical signs of respiratory illness first the first 21 days and then once daily for the remainder of the study. Clinical illness scores (CIS) and rectal body temperature were used to identify and confirm illness. CIS system was as follows (1- normal, 2- Mild depression, 3- severe depression, 4- Moribund). Respiratory illness was treated as follows: first treatment was florfenicol (Norfenicol; Norbrook, Lenexa, KS) and a vitamin and mineral drench (Bovitalize; Bimeda, Schaumburg, IL), second treatment was enrofloxacin (Enroflox 100; Norbrook, Lenexa, KS), and third treatment was oxytetracycline (Noromycin 300 LA; Norbrook, Lenexa, KS). Heifers that continued to show signs of illness after third treatment were declared as chronic and

removed from the experiment. During the trial, five animals were found dead in pen (White A - 2, Red B - 1, and Blue C - 2). Necropsy confirmed animal death was related to bronchopneumonia linked to Bovine Respiratory Disease Complex (BRD). A total of 22 animals were removed from the study: 19 Chronic respiratory cases (6 - A, 9 - B, and 4 - C), 2 for lameness (1 - B and 1 - C), and 1 for chronic bloat (Treatment A).

To measure water usage, iPERL water meters (SENSUS, Morrisville, NC) were connected to individual automatic waterers (Lil' Spring 3000; Miraco Livestock Water Systems, Grinnell, IA) for each pen. To measure dry matter intake, all calves were fed a common diet composed of 40.00% Sweet Bran (Cargill Animal Nutrition, Blair, NE), 30.01% prairie hay, 24.37% dry-rolled corn, and 5.63% pellet supplement. This ration was formulated to provide 53 Mcal net energy for gain and offered at *ad libitum* intake. Feed bunks were read at 0700h each day and were targeted to be empty when feed was delivered at 0800h. When a feed refusal was present, feed was weighed, sample was taken for dry matter, feed did not return to the bunk, and feed call adjustment was made for that day. Pen weights were collected on days 0, 28, and 56 of the study using a pen scale (Rice Lake Weighing Systems, Rice Lake, WI). Pen weights and head counts were used to determine average weight of individual animals to calculate average daily gains for the study.

Statistical Analysis

Performance, dry matter intake, and water usage data were analyzed using the MIXED procedure of SAS (version 9.4; SAS Institute., Cary, NC). The model for body weights, average daily gains, and feed efficiency included treatment as a fixed effect and block as a random effect. For dry matter intake and water usage, the initial model contained fixed effects of treatment, day, and treatment × day. No treatment × day interactions were present ($P = 0.82$); therefore, the final model included a fixed effect of treatment and random effect of block. Health data were analyzed as binomial proportions of first, second, and third respiratory treatment and mortality using the GLIMMIX procedure of SAS (version 9.4; SAS Institute., Cary, NC). The model included fixed effects of treatment and random effects of block.

Results and Discussion:

Following the 56-day backgrounding period, heifer's final body weight and average daily gains did not differ ($P \geq 0.35$; Table 1) between treatments. Dry matter intake and feed efficiency showed no difference ($P \geq 0.53$) among treatments. Water usage did not differ ($P = 0.51$; Table 1) amongst treatments either.

Implication:

Data presented suggest that the arrival combination of the following vaccine treatments had no negative effects on heifer's growth performance, feed efficiency, or health outcome. It is important to keep in mind the health status of the cattle being vaccinated as well as number of injections given during a processing event. The results of this study would conclude that the following treatments did not differ in performance or health status of the cattle.

Table 1. Effect of arrival vaccine on growth performance, feed intake, feed efficiency, and water usage of newly received beef heifers

	Treatment[1]				
Item,	Pyramid	Stimulator	Bovi-Shield Gold	SEM[2]	*P*-value[3]
No. of observations	9	9	9		
No. of heifers	122	120	124		
Body weight, lb					
d 0	500	499	499	2.4	0.82
d 28	595	589	601	4.9	0.16
d 56	675	672	682	5.0	0.36
Average daily gain, lb/d					
0-28	3.41	3.23	3.67	0.159	0.16
28-56	2.83	2.96	2.88	0.168	0.71
0-56	3.12	3.09	3.27	0.092	0.35
Dry matter intake, lb/d					
0-14	10.11	10.34	10.49	0.287	0.65
15-56	16.66	16.79	17.24	0.414	0.59
0-56	15.02	15.18	15.55	0.359	0.57
Gain:feed, lb/lb					
0-56	0.21	0.20	0.21	0.005	0.53
Feed:gain, lb/lb					
0-56	4.82	4.92	4.77	0.106	0.46
Water usage, gal/d					
0-14	4.54	4.48	4.86	0.200	0.36
15-56	5.08	5.13	5.31	0.249	0.62
0-56	4.94	4.97	5.20	0.171	0.51

[1] Vaccine treatments applied on d 0. Pyramid: (Pyramid 5 + Presponse SQ; Boehringer Ingelheim, Ridgefield, CT) and (Vision 7 Somnus; Merck Animal Health, Rahway, NJ); Stimulator: (Stimulator 5; Bimeda, Schaumburg, IL), (Pro-Bac 4; Bimeda, Schaumburg, IL), and (Vision 7; Merck Animal Health, Rahway, NJ; Bovi-Shield Gold: (Bovi-Shield Gold One Shot; Zoetis Inc., Parsippany, NJ) and (Vision 7 Somnus; Merck Animal Health, Rahway, NJ).

[2] Largest standard error of the mean.

[3] Treatment main effect.

Table 2. Effect of arrival vaccine on health of newly received beef heifers

	Treatment[1]				
Item,	Pyramid	Stimulator	Bovi-Shield Gold	SEM[2]	*P*-value[3]
Morbidity, %					
Treated once[4]	52.67	45.04	41.22	0.327	0.17
Treated twice[5]	25.95	27.48	16.03	0.264	0.10
Treated thrice[6]	7.63	13.74	7.63	0.355	0.37
Chronic[7]	4.58	7.63	3.05	0.533	0.76
Mortality,[8] %	1.53	0.76	1.53	1.049	1.00

[1] Vaccine treatments applied on d 0. Pyramid: (Pyramid 5 + Presponse SQ; Boehringer Ingelheim, Ridgefield, CT) and (Vision 7 Somnus; Merck Animal Health, Rahway, NJ); Stimulator: (Stimulator 5; Bimeda, Schaumburg, IL), (Pro-Bac 4; Bimeda, Schaumburg, IL), and (Vision 7; Merck Animal Health, Rahway, NJ; Bovi-Shield Gold: (Bovi-Shield Gold One Shot; Zoetis Inc., Parsippany, NJ) and (Vision 7 Somnus; Merck Animal Health, Rahway, NJ).

[2] Largest standard error of the mean.

[3] Treatment main effect.

[4] Percentage within treatment of heifers treated once for bovine respiratory disease (BRD).

[5] Percentage within treatment of heifers treated a second time for BRD out of total population (heifers treated twice ÷ total population).

[6] Percentage within treatment of heifers treated a third time for BRD out of total population (heifers treated thrice ÷ total population).

[7] Percentage within treatment of heifers removed from the experiment due to BRD (removed heifers ÷ total population).

[8] Percentage within treatment of heifers within treatment that died from BRD-related illness.