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## Reproduction

### Influence of Bovine Viral Diarrhea Virus Infection on Artificial Insemination Conception and Breeding Season Pregnancy Success in Vaccinated Beef Herds

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#### Objective

To compare the effects of unintentional BVDV infection in well vaccinated herds on AI conception rate and breeding season pregnancy success.

#### Study Description

Vaccinated cows (n=370) and heifers (n=528) from nine different herds were synchronized using the 7-day CO-Synch + CIDR protocol and were fixed-time AI (FTAI). On d 28 following insemination, blood samples were collected and pregnancy status was determined. Non-pregnant animals were resynchronized and FTAI occurred a second time. In six herds bulls were comingled with females beginning 10-15 d after the second AI. Final pregnancy status was determined 33-80 d following the first pregnancy diagnosis. Blood samples were tested for the presence of BVDV antigen using the IDEXX BVDV PI X2 Kit. Animals that tested positive were considered infected with BVDV at the time of blood collection. Herds were determined to be BVDV infected by the presence of at least one animal having a positive test for antigen (n = 4 infected herds, n = 5 non-infected herds). Herds that had evidence of BVDV infection at d 28 following insemination had significantly decreased (P<0.01) first service AI conception rates compared to herds that had no evidence of infection ( $34 \pm 2.3\%$  vs.  $54 \pm 2.3\%$ ). Additionally, breeding season pregnancy rates were decreased (P<0.01) in BVDV infected herds compared to non-infected herds ( $69 \pm 3.4\%$  vs.  $80 \pm 3.6\%$ ). There was no significant effect of BVDV infection status on embryonic loss (P=0.42) or percentage of animals which lost a pregnancy and rebred by the end of the breeding season (P=0.63). In conclusion, BVDV infection in well vaccinated herds had a significant negative impact on both first service AI conception rate and overall breeding season pregnancy success.

#### Take home points

- Infection of BVDV during the breeding season in vaccinated herds negatively influenced first service AI conception rate, total AI pregnancy rate after two inseminations, as well as the overall breeding season pregnancy rate.
- Despite the vaccination status of the infected herds, pregnancy success was reduced by 20% in herds infected with BVDV.

- Vaccination programs are a beneficial component of herd health management; however, biosecurity and testing practices should also be utilized to prevent reproductive loss mediated by BVDV.

**Keywords:** Bovine Viral Diarrhea Virus, pregnancy success, vaccination

## **Influence of Bovine Viral Diarrhea Virus Infection on Artificial Insemination Conception and Breeding Season Pregnancy Success in Vaccinated Beef Herds**

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### **Abstract**

Bovine Viral Diarrhea Virus (BVDV) causes reproductive economic losses in cattle. The objective of this study was to evaluate the influence of BVDV infection on reproductive success. Vaccinated cows (n = 370) and heifers (n = 528) from nine different herds were synchronized using the 7-day CO-Synch + CIDR protocol and were bred using fixed-time artificial insemination (FTAI). On d 28 following insemination, blood samples were collected and pregnancy status was determined. Non-pregnant animals were resynchronized and FTAI occurred a second time. In six herds, bulls were comingled with females beginning 10-15 d after the second AI. Final pregnancy status was determined 33-80 d following the first pregnancy diagnosis. Blood samples were tested for the presence of BVDV antigen using the IDEXX BVDV PI X2 Kit. Animals that tested positive were considered infected with BVDV at the time of blood collection. Herds were determined to be BVDV infected by the presence of at least one animal having a positive test for antigen (n = 4 infected herds, n = 5 non-infected herds). Statistical analyses were performed using the GLIMMIX procedure of SAS with herd as a random variable. Herds that had evidence of BVDV infection at d 28 following insemination had significantly decreased ( $P < 0.01$ ) first service AI conception rates compared to herds that had no evidence of infection ( $34 \pm 2.3\%$  vs.  $54 \pm 2.3\%$ , respectively). Additionally, breeding season pregnancy rates were decreased ( $P < 0.01$ ) in BVDV infected herds compared to non-infected herds ( $69 \pm 3.4\%$  vs.  $80 \pm 3.6\%$ , respectively). There was no significant effect of BVDV infection status on embryonic loss ( $P = 0.42$ ) or percentage of animals which lost a pregnancy and rebred by the end of the breeding season ( $P = 0.63$ ). In conclusion, BVDV infection in well vaccinated herds had a significant negative impact on both first service AI conception rate and overall breeding season pregnancy success.

### **Introduction**

Bovine Viral Diarrhea Virus (BVDV) is a major reproductive pathogen in cattle and is responsible for costly reproductive and other economic losses in the beef industry. Evidence of exposure to BVDV is widespread throughout cattle herds in the United States and the world. It is reported that calves born persistently infected (PI) with BVDV represent as much as 1-2% of the cattle population and serve as sources of viral shedding through the duration of their lives (Houe, 1999). When considering the rise of BVDV-related reproductive loss in cattle (Evermann, 2002), this area of BVDV-mediated loss may pose the greatest economic concern compared to losses incurred through respiratory, immune, and neurological dysfunction caused by BVDV (Grooms, 2004). Infection of females in the breeding herd can result in a variety of consequences depending on which stage of gestation infection occurs. The most commonly observed effects are poor conception rates, abortion, congenital defects, or birth of PI calves. Infection with BVDV in cows lacking BVDV antibodies during the breeding season resulted in a 56.4% reduction in conception rates compared to cows that had established BVDV antibodies prior to the breeding season (Virakul, 1988). In addition, BVDV present in the blood of previously non-

vaccinated animals at time of artificial insemination (AI) significantly reduced first service conception rates (Yavru, 2013). These studies report the impact of BVDV on reproductive performance in naïve animals. Little is known, however, about the reproductive consequences of BVDV infection in well-vaccinated animals. Therefore, the objective of this study was to evaluate the influence of BVDV infection on reproductive success after AI, and at the end of the breeding season in previously vaccinated animals. It was hypothesized that vaccinated herds infected with BVDV would have impaired reproductive success after AI and at the end of the breeding season compared to non-infected herds.

### Experimental Procedures

Beef cows and heifers (n = 370 cows, n = 528 heifers) from nine herds in the state of South Dakota were utilized in the study. All animals utilized had received vaccinations for BVDV (Table 1) as heifers, and as cows were given yearly boosters. The most recent vaccination was administered a minimum of 30 d prior to the first AI. Four herds (three groups of heifers and one group of cows) were housed at a commercial heifer development facility for the entire breeding season. Animals at this facility were likely exposed to BVDV by purchased animals that were brought to the facility and then either allowed to comingle or have fence line contact with other animals without having been tested and/or quarantined.

Animals were synchronized using the 7-day CO-Synch + CIDR protocol and FTAI as part of ongoing reproductive research efforts. In brief, animals were administered GnRH (100 µg as 2 mL of Factrel i.m.; Zoetis, Inc., Kalamazoo, MI) on d -10, and a CIDR (Zoetis, Inc., Kalamazoo, MI) was inserted intravaginally. On d -3 CIDRs were removed and PGF2α was administered (PGF2α; 25 mg as 2 mL Lutalyse HighCon i.m.; Zoetis, Inc., Kalamazoo, MI). On d 0, heifers were bred 52-56 h and cows 60-66 h after PGF2α, and GnRH (100 µg as 2 mL of Factrel i.m.; Zoetis, Inc., Kalamazoo, MI) was administered at time of AI (AI 1). On d 21 following the first insemination, the animals were resynchronized using the 7-day CO-Synch protocol with or without a CIDR. At this time all animals received an injection of GnRH (100 µg as 2 mL of Cystorelin i.m.; Boehringer Ingelheim; Ridgefield, CT), and half of the animals received a CIDR while the other half did not as part of the aforementioned reproductive research efforts. On d 28, CIDRs were removed, blood samples were collected and all animals were examined by transrectal ultrasonography for pregnancy. Those determined not pregnant via ultrasound and the IDEXX Rapid Visual Pregnancy Test were administered PGF2α (25 mg as 2 mL SynchSure i.m.; Boehringer Ingelheim; Ridgefield, CT) and animals were artificially inseminated 52-56 h and 60-66 h later (heifers and cows, respectively) and GnRH (100 µg as 2 mL of Cystorelin i.m.) was administered at time of AI (AI 2). Estrus activity was evaluated at the time of AI 1 and AI 2 by visualizing an Estrotect patch (Estrotect, Western Point, Inc., Apple Valley, MN) that had been applied to females at the time of PGF2α of each protocol.

On d 28 after AI 1, blood was also collected from the jugular or tail vein into 10-mL EDTA Vacutainer tubes (Becton, Dickinson and Company, Franklin Lakes, NJ) for immediate whole blood analysis via the IDEXX Rapid Visual Pregnancy Test (IDEXX, Westbrook, ME). Remaining whole blood samples were centrifuged for plasma collection. Harvested plasma samples were then stored at -20°C until testing with the IDEXX BVDV PI X2 Kit (IDEXX, Westbrook, ME). A final

pregnancy diagnosis was conducted solely with transrectal ultrasonography between 33 to 80 days following the first pregnancy diagnosis.

### Results and Discussion

In the d 28 blood samples, 18 animals were found to be positive for BVDV antigen and were isolated to four herds which were then classified as BVDV infected. Herd estrus expression prior to AI 1 was decreased by BVDV infection status ( $P = 0.04$ ). Infected herds had an estrus expression rate of  $54 \pm 2.3\%$ , while the non-infected herds had a rate of  $62 \pm 2.9\%$ . Herd BVDV infection status, however, did not influence estrus expression prior to AI 2 ( $P = 0.30$ ). At this time, infected herds had an AI 2 estrus expression rate of  $56 \pm 2.9\%$  and  $61 \pm 3.9\%$  for non-infected herds. First service AI conception rate was influenced by BVDV infection ( $P < 0.01$ ). Herds which were infected with BVDV had a decreased AI 1 conception rate compared to herds with no BVDV infection ( $34 \pm 2.3\%$  vs.  $56 \pm 2.3\%$ , respectively). Additionally, there was a tendency ( $P = 0.06$ ) for pregnancy success to be reduced in BVDV infected herds after AI 2 compared to non-infected herds ( $37 \pm 4.4\%$  vs.  $51 \pm 9.5\%$ , respectively). When conception rates for AI 1 and 2 were analyzed collectively, a similar response was observed. Infected herds had decreased conception rates after two rounds of AI compared to non-infected herds ( $51 \pm 2.3\%$  infected vs.  $68 \pm 2.3\%$  non-infected,  $P < 0.01$ ). Overall breeding season pregnancy success was influenced by herd BVDV infection status ( $P < 0.01$ ). Herds with evidence of BVDV infection had decreased breeding season pregnancy rate compared to non-infected herds ( $68 \pm 3.1\%$  vs.  $88 \pm 6.9\%$ , respectively). These results are summarized in Table 2.

### Implications

In the present study, evidence of BVDV infection was associated with decreased first, second, and overall breeding season pregnancy rates in previously vaccinated heifers and cows. Although vaccination remains an important consideration, this method alone is not capable of eliminating the risk of BVDV associated reproductive and economic loss. Because BVDV remains a contributor to infertility, the significance of its ability to remain a reproductive barrier for well vaccinated herds should be carefully considered. The demonstrated ability of BVDV to hinder reproductive function and subsequently decrease pregnancy success in the present study draws attention to the need for biosecurity measures and routine BVDV testing for PI animals to be included in herd management practices. Thus, recommendations for effective reproductive management of beef herds include regular vaccination for aid in control of detrimental infectious reproductive diseases and testing to decrease the possible exposure to infectious reproductive diseases.

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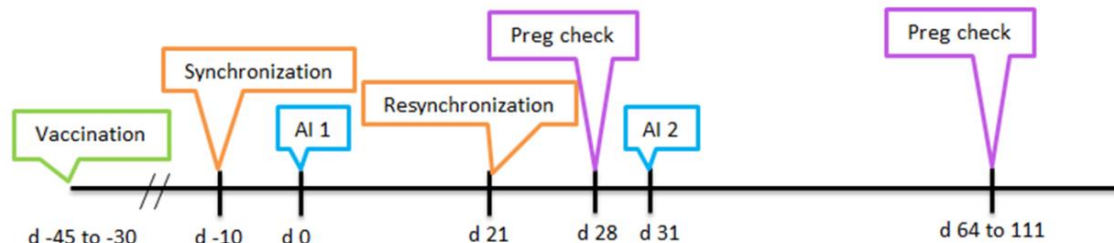
**Table 1.** Records of herd size, age, most recent vaccination, and number of days the most recent vaccination was administered before AI.

Herd	Herd size	Age	Most recent vaccination	Vaccination days pre-breeding
1	135	heifers	Vista 5 VL5	30+ d prior
2	91	heifers	Bovishield Gold FP5 VL5	30+ d prior
3	154	heifers	Vista 5 VL5	30+ d prior
4	79	cows	CattleMaster Gold FP5 L5	30+ d prior
5	85	heifers	Bovishield Gold FP5 VL5	45 d prior
6	45	cows	Bovishield Gold FP5 VL5	45 d prior
7	97	cows	PregGuard-9	30+ d prior
8	151	cows	Bovishield Gold FP5 VL5	30+ d prior
9	70	heifers	Bovishield Gold FP5 VL5	30+ d prior

**Table 2.** Influence of BVDV infection on estrus expression and pregnancy rates.

BVDV Status	Herds (n)	# Hd	Estrus expression		Pregnancy			Breeding Season
			AI 1	AI 2	AI 1	AI 2	AI 1 and 2	
Infected	4	456	54 ± 2.3% <sup>c</sup>	56 ± 2.9%	34 ± 2.3% <sup>a</sup>	37 ± 4.4% <sup>e</sup>	51 ± 2.3% <sup>a</sup>	68 ± 3.1% <sup>a</sup>
Non-infected	5	442	62 ± 2.9% <sup>d</sup>	61 ± 3.9%	56 ± 2.3% <sup>b</sup>	51 ± 9.5% <sup>f</sup>	68 ± 2.3% <sup>b</sup>	88 ± 6.9% <sup>b</sup>

Values within a column having different superscripts are different <sup>ab</sup>*P* < 0.01, <sup>cd</sup>*P* = 0.04, <sup>ef</sup>*P* = 0.06



**Figure 1.** Timeline of study events.