PEER REVIEWED

# Acute Trichomoniasis and Sub-Optimal Bull Fertility in a Cow/Calf Herd: an Investigation and Case Management

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**Abstract**

A beef cow/calf ranch contacted the veterinary teaching hospital concerning low pregnancy rates. The 600-cow herd consisted of three breeding groups of females, with each group being exposed to multiple-sire bull batteries for 90 days (April-June). Each breeding group was palpated for pregnancy approximately 60 days following bull removal from the cows. Pregnancy rates in the groups were 60, 25 and 41%. No abortions had been observed by management during or following the breeding season. Initial work-up found that each group of cows was in adequate body condition for reproduction. A high percentage of the ranch's bull population was positive for culture and polymerase chain reaction for *Tritrichomonas foetus*. In addition, a high percentage of the bull population failed to pass a breeding soundness examination. Treatment recommendations included culling the entire bull population and replacing it solely with virgin bulls that had passed a breeding soundness examination. Simultaneously, we recommended administration of a *T. foetus* vaccine to all females, followed by a vaccine booster dose 30 days later. All non-pregnant females were to be placed in separate breeding groups and exposed to the new bull population for 60 days (Dec-Jan). Palpation of non-pregnant females was to be performed 60 days following bull removal. The ranch followed these treatment recommendations. Following bull removal 60-day pregnancy rates were 95%. All replacement bulls passed a breeding soundness examination and were negative for *T. foetus* by polymerase chain reaction following exposure to the non-pregnant females. Ninety-eight percent of pregnant cows from the original bull exposure (April-June) delivered term calves.

**Résumé**

Un élevage vaches/veaux a contacté l'hôpital vétérinaire d'enseignement à propos d'un faible taux de gestation. Le troupeau de 600 têtes comportait trois groupes reproducteurs de vaches tous exposés à un groupe de taureaux durant 90 jours (Avril-Juin). Chaque groupe était palpé pour la gestation approximativement 60 jours suivant le retrait des taureaux. Le taux de gestation par groupe était de 60%, 25% et de 41%. Aucun avortement n'a été détecté par les travailleurs durant et suivant la saison de reproduction. Des examens au préalable portaient à croire que les vaches de chaque groupe présentaient une condition corporelle acceptable pour la reproduction. Une proportion élevée de taureaux dans cet élevage testait positif pour *Trichomonas fœtus* sur la base de cultures et par la réaction en chaîne de la polymérase. De plus, un fort pourcentage de taureaux ne passait pas l'examen d'aptitude à la reproduction. Les recommandations de traitement incluaient l'abattage de tous les taureaux et le remplacement par des taureaux vierges passant l'examen d'aptitude à la reproduction. Simultanément, nous recommandions l'administration d'un vaccin contre *T. fœtus* à toutes les vaches suivi d'un rappel 30 jours plus tard. Toutes les vaches non-gravides devaient être placées dans des groupes séparés et exposées à la nouvelle population de taureaux pendant 60 jours (Déc. – Janv.). La palpation des vaches non-gravides devaient prendre place 60 jours suivant le retrait des taureaux. L'élevage suivi ces recommandations. Suite au retrait des taureaux, le taux de gestation après 60 jours était de 95%. Tous les taureaux de remplacement ont passé l'examen d'aptitude à la reproduction et testaient négatif pour *T. foetus* sur la base de la réaction en chaîne de polymérase

suivant l'exposition aux vaches non-gravides. Un total de 98% des vaches gestantes de la première vague d'exposition aux taureaux (Avril-Juin) ont mis bas à terme.

## Introduction

Trichomoniasis is a venereal disease of cattle that causes infertility and pregnancy loss in cows and asymptomatic, permanent infection in bulls. The causative agent, *Tritrichomonas foetus*, is a flagellated protozoan characterized by three anterior and one posterior flagella.[21] Trichomoniasis was first reported in the United States in the 1930s as a cause of bovine abortion and has been subsequently reported worldwide.

Pregnancy losses due to trichomoniasis are common in the first trimester of pregnancy and may occur through the fifth month of gestation.[8] Pyometra in infected cows is not uncommon. Cows will usually recover from an initial infection three to four months after fetal loss and develop short-term protective immunity.[4] Re-exposure to the organism in subsequent years may produce pregnancy losses, but a shorter time period is required for the cow to recover and re-develop short-term immunity. In few instances, a cow may become a carrier by becoming infected, yet carrying the pregnancy to term and thus shedding the organism following parturition.[21] Bulls harbor the organism in the preputial crypts and once infected are considered infected for life.[3] Bulls less than four years of age are less susceptible to permanent infection. To date, there is no licensed drug treatment for trichomoniasis in the United States. *T. foetus* infections in beef herds can substantially impair the economic viability of a ranching enterprise.[18,19]

This report describes the reproductive performance of a beef herd whose managers failed to perform pre-breeding, breeding soundness examinations on the bull population and had an inadequate biosecurity program for trichomoniasis. Specifically described are the history, clinical and laboratory findings, and therapeutic management of a trichomoniasis-infected beef herd with a sub-fertile bull population.

## History

Managers of an East Texas ranch contacted the Food Animal Field Service Section of the Texas A&M University Veterinary Medical Teaching Hospital in October 2003 about low pregnancy rates in their 600-cow herd. Historical pregnancy rates were at or near 90%. The breeding season was 90 days long (April-June), and mating was accomplished with a multiple-sire bull population (21 Red Angus bulls) with a bull-to-female ratio of approximately 1:29. The herd was divided into three breeding groups. Group 1 consisted of 285 Brahman x Hereford cows with ages of four to 14 years. Group 2 consisted of 265 Red Angus x Brahman cows with ages of two to four years. Group 3 consisted of 66 Red Angus heifers 17 to 20 months of age. All females were palpated for pregnancy 60 days following bull removal. Pregnancy rates for Groups 1-3 were 60 (170/285), 25 (66/265) and 41% (27/66), respectively. The overall pregnancy rate for the 90-day breeding season was 43% (263/616). No abortions had been observed by management during or following the breeding season.

All females received an infectious bovine rhinotracheitis- bovine virus diarrhea - parainfluenza$_3$- bovine respiratory syncytial virus vaccine (modified live and killed virus)- *Campylobacter fetus- Leptospira canicola- L. grippotyphosa- L. hardjo- L. icterohaemorrhagiae- L. pomona* bacterin[a] pre-breeding (30 days prior to bull turn-out). The 21 bulls that comprised the multiple-sire bull population received no vaccine, nor had breeding soundness examinations performed during the pre-breeding period. All bulls were originally purchased as yearlings (14 to 16 months of age) and were represented at the time of purchase as virgins. However, the ranch allowed six bulls to service cows at a neighboring ranch prior to servicing their own cows in the current production year. No records existed to identify the six bulls used to service cows in both herds.

## Clinical and Laboratory Findings

On examination, some individual cows were thin (BCS $\leq$ 4), but on average the body condition (scale 1-9) was adequate, BCS $\geq$ 5. Cattle had substantial forage available to maintain body condition, with a stocking density of one cow/calf unit per eight acres. A balanced mineral was available free choice.

Based on history and clinical findings, preliminary differential diagnoses were infectious causes of first and second trimester reproductive failure (*Tritrichomonas foetus*, *Campylobacter fetus*, *Neospora caninum*, BVD virus) as well as sub-optimal bull fertility.

Thirty-six of the non-pregnant heifers in breeding Group 3 were rectally palpated, and three were diagnosed with pyometra. Blood samples were randomly collected from 20 of these heifers for future serologic diagnostic work-up into the cause of the low pregnancy rates.

Examination of the bull population revealed that the majority were in low body condition (mean BCS 4.3). Bulls ranged in age from three to six years, with a mean age of four and one-half years. A breeding soundness examination using guidelines from the Society for Theriogenology[6] was performed on each of the 21 bulls. Nine of 21 bulls (43%) failed to achieve a satisfactory potential breeder rating. Of the bulls that failed, eight had excessive defects in sperm morphology and one failed because of a penile injury.

Each bull was subsequently cultured for *T. foetus* by inserting a sterile infusion pipette with 20 ml syringe into the preputial orifice and scraping along the penile surface near the preputial fornix. Each smegma sample was immediately inoculated into culture media.[b] Cultures were transported to the Diagnostic Parasitology Laboratory, College of Veterinary Medicine, Texas A&M University for laboratory diagnostics. Cultures were maintained at 98.6° F (37° C) by the laboratory. Each sample was examined daily for five days using light microscopy to detect trichomonad motility. Eight of the 21 bulls were found culture-positive for *T. foetus*. Each positive culture was submitted for polymerase chain reaction (PCR) analysis,[11] and all eight culture-positive samples were also PCR-positive for *T. foetus*. Of the eight bulls found infected with *T. foetus*, at least one had been in service in each of the three breeding groups.

Of the 21 bulls, seven were determined to have inadequate fertility, six were found to be infected with *T. foetus*, and two were found to have both inadequate fertility and *T. foetus* infection. Serological assays were not performed on samples collected from heifers in Group 3 because the combined evidence (history of loaning bulls, pyometras, *T. foetus*-infected bulls, poor bull fertility) supported a diagnosis of trichomoniasis and suboptimal bull fertility.

## Therapeutic Management

Existing recommendations for control of trichomoniasis in a beef herd are varied.[3,21] Most control strategies are focused on culture and cull of infected bulls, as well as replacing infected bulls with virgin bulls. Based on multiple studies, the sensitivity of a single *T. foetus* preputial culture using the InPouch™ TF[b] system is 81-95%,[3] therefore the recommended culture protocol for bulls is to culture three times at weekly intervals (95-99% sensitivity).[3] One recently identified problem is that intestinal or coprophilic trichomonad protozoa might be present in culture and be misidentified as *T. foetus*.[2] Recent diagnostic methodologies have included the development and use of *T. foetus*-specific PCR methods which are capable of increasing both sensitivity and specificity of diagnosis.[5,7,10,11,16,17,20]

Other recommendations include segregating cows into exposed and unexposed breeding groups, and culling non-pregnant females. A commercially available killed whole-cell vaccine[c,d] licensed to aid in the prevention of *T. foetus* infections in females is available as either a monovalent, or part of a polyvalent vaccine containing campylobacter and leptospira. Reports on efficacy of vaccines used to prevent *T. foetus* infection in females have resulted in varied, but beneficial results.[9,12-15]

A multi-faceted therapeutic approach was considered to address the animal health problems identified on this ranch. The first recommendation was to cull all bulls and replace them with a population of virgin bulls deemed satisfactory potential breeders per breeding soundness examinations based on Society for Theriogenology guidelines.[6] Recommendations were also given to administer two doses of a polyvalent *T. foetus* vaccine[d] a month apart (Nov 1, Nov 30) to all females, and to segregate the non-pregnant cows into separate breeding groups and expose them to the new bulls for 60 days (Dec-Jan). Non-pregnant females were to be examined for pregnancy 60 days following bull removal and non-pregnant females should be culled.

The ranch followed these treatment recommendations. New bulls consisted of 10 virgin, 16 to 18 month old, Red Angus bulls that had passed a pre-purchase breeding soundness examination. All females were vaccinated with *T. foetus* vaccine and administered a booster dose.[d] After segregating exposed, non-pregnant females into separate breeding groups, the ranch culled 56 females in this group because of low body condition, advanced age, feet and udder problems, etc. The pregnancy rate 60 days following bull removal from this group was 95% (282/297). All non-pregnant females were culled. All replacement bulls passed a breeding soundness examination and were negative for *T. foetus* via PCR analysis following exposure to the non-pregnant females (post-breeding). Of the pregnant cows from the original (April-June) bull exposure, 98% (258/263) delivered term calves. The pregnancy rate of exposed females went from an initial 43% (263/616) to 88.5% ((263 + 282)/616) during our investigation.

Biosecurity recommendations were given, which included a moratorium on use of untested bulls from outside the ranch, no longer allowing neighbors to use their bulls and purchasing only virgin replacement cattle (male or female). An immunization program for the bulls was designed, which included the use a respiratory viral, leptospira, campylobacter vaccine at pre-breeding time. Management was advised to have bulls cultured for *T. foetus* and breeding soundness examinations performed pre- and post-breeding for subsequent breeding seasons.

The management from the neighboring ranch which had borrowed six bulls from this ranch consented to a one-time culture of its complete bull population (39 bulls). All cultures were negative for *T. foetus*.

## Discussion

Many prevention/control strategies for trichomoniasis include culling of non-pregnant, exposed females. This was not a viable recommendation in the case described here because of the high percentage (57%) of non-pregnant exposed females. Segregation of these females into distinct breeding groups allowed for a sec-

ond breeding season (split calving), five months from the end of the initial breeding. The intent of this decision was to minimize financial losses due to increased culling/replacement rates, and to optimize the timing of breeding with the onset of natural immunity following primary exposure/infection.

The use of the vaccine[d] (and booster dose) served multiple purposes. It stimulated immune components in the exposed, non-pregnant females, thus potentially decreasing the convalescent period from infection to clearance of the organism. Use of the vaccine[d] and a booster in the pregnant females (five to nine months pregnant at the time of immunization) served to potentially decrease the risk of additional abortions in this group, as well as to stimulate immunity in females that might have become carriers.

The recommendation to cull all bulls in lieu of utilizing the standard three cultures at weekly intervals was made because of the high prevalence (38%) of infected bulls found on initial culture, as well as the high percentage of bulls that did not pass the breeding soundness exam (43%). Purchase and use of virgin bulls that had passed a pre-purchase breeding soundness examination provided minimal risk for introduction of new infection to the females in the second breeding season, and minimized risk of one or more of these bulls becoming permanently infected if exposed to an infected cow. Management was advised not to lend bulls to neighboring ranches, nor to accept bulls on loan from neighboring ranches without three negative cultures performed at weekly intervals. While the institution of a split-calving season allowed for favorable control of an acute trichomoniasis outbreak, it also allowed the ranch to reduce the total number of bulls needed on a yearly basis from 21 to 10. The split-calving season has presented the ranch with additional management and marketing opportunities, which could exert a long-term influence on overall productivity.

The impact of sub-optimal fertility in the original bull population on low pregnancy rates in this report cannot be quantified. Bulls were used in the original breeding season without having pre-breeding, breeding soundness examinations performed. We cannot speculate about the timing or the underlying reason for poor performance on the breeding soundness examinations performed three and one-half months after the end of the breeding season. The bulls were in poor body condition, and this alone has been attributed to failure to pass a breeding soundness examination.[1]

A herd infected with *Campylobacter fetus* can present with a similar history and signalment as found in the case reported here. Utilization of vaccine against this organism can prevent herd-level infections. All females were vaccinated against *C. fetus* prior to the April-June breeding season, and females that composed the breeding group for the second breeding season (Dec-Jan) received two-doses of vaccine in November and were exposed to virgin bulls. These measures provided adequate protection from a herd-level campylobacterosis problem.

In this case, success of control measures was evident shortly after the end of the second breeding season. The pregnancy rate for the second breeding season was 95% at 60 days following the end of the breeding season, and all bulls achieved a satisfactory potential breeder classification on the post-breeding, breeding soundness exam. Also, all bulls were negative to *T. foetus* based on a post-breeding PCR analysis. The calving rate for females diagnosed pregnant from the original bull exposure was high (98%).

## Conclusion

This report gives insight into the history, signalment and diagnostics employed in the investigation of an acute outbreak of trichomoniasis in a cow/calf operation. It also serves to underscore the role that biosecurity and routine reproduction procedures (breeding soundness exams) have in optimizing the reproductive efficiency in a cow/calf operation. Multi-faceted control measures which included use of virgin bulls, vaccination of females and segregation of non-pregnant exposed females into separate breeding groups allowed the ranch to return to pre-infection levels of reproductive performance.

## Footnotes

[a] Cattlemaster® 4 Plus VL5, Pfizer Animal Health, New York, NY

[b] InPouch™ TF, Biomed Diagnostics, San Jose, CA

[c] TrichGuard®, Fort Dodge Animal Health, Fort Dodge, IA

[d] TrichGuard® V5L, Fort Dodge Animal Health, Fort Dodge, IA

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# Abstract

## Managing Hypocalcemia and Milk Fever

Goff J.

*Cattle Practice* (2004) 11(2):75-79

The onset of lactation places such a large demand on the calcium homeostatic mechanisms of the body that most cows develop some degree of hypocalcemia at calving (Goff *et al* 1987, Horst *et al* 1994). In some cases, plasma calcium concentrations become too low to support nerve and muscle function, resulting in parturient paresis or milk fever. The factors, such as dietary cation-anion balance and blood alkalinity, that determine the degree of hypocalcemia a cow will experience at calving will be discussed later. However, it now seems clear that hypocalcemia has some widespread effects on the cow that predispose the cow to other periparturient diseases (Curtis *et al* 1983).

Cows developing milk fever have higher plasma cortisol concentrations than do non-milk fever cows (Goff *et al* 1989, Horst and Jorgensen 1982, Littledike *et al* 1970), which may exacerbate immunosuppression ordinarily present at calving. Hypocalcemia also results in the loss of muscle tone in the uterus and teat sphincter, which, combined with the immunosuppressive effects of the excess cortisol, may account for the increased incidence of retained placenta and mastitis observed in cows with milk fever. Loss of uterine muscle tone is a major cause of uterine prolapse, and this disease process is almost always due to hypocalcemia (Risco *et al* 1984).

Milk fever cows also exhibit a greater decline in feed intake after calving than non-milk fever cows (Goff and Horst 1997, Marquardt *et al* 1977), exacerbating the negative energy balance commonly observed in early lactation. In addition, hypocalcemia prevents secretion of insulin (Littledike *et al* 1970), preventing tissue uptake of glucose which would exacerbate lipid mobilization at calving, increasing the risk of ketosis. The decline in feed intake associated with milk fever would reduce rumen fill (so rumen sits above floor of abdomen) and the depth of the rumen matte allowing more VFA into the abomasum. It also would reduce abomasal contractility. All these effects of hypocalcemia predispose the cow to displacement of the abomasum.