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Determining potential pregnancy status differences based on a new method of yearling heifer prebreeding examination

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ABSTRACT

The study objective was to evaluate the Ready-Intermediate-Problem (RIP) replacement heifer evaluation matrix's ability to classify heifers into groups with differing reproductive outcomes. Beef heifers (n = 341) from six Kansas herds were classified according to RIP matrix guidelines and then exposed to AI breeding, bull breeding, or a combination of both as per the management plans for each participating herd. Following the breeding season the heifers were evaluated to determine pregnancy status, AI pregnancy status, days bred, and the number of 21 day cycles needed during the breeding season to become pregnant. After the breeding season, 298 (87%) of the heifers were pregnant, 204 (68%) of which became pregnant in the first 21 days of the breeding season. There was a significant interaction ($P = 0.01$) in RIP classification and pregnancy by 21 day cycle. Ready classified heifers had a significantly greater risk of becoming pregnant after a single AI exposure ($P = 0.03$) and in the first 21-day cycle ($P = 0.02$) compared to Problem classified heifers, and significantly less risk of being non-pregnant at the end of the breeding season ($P < 0.01$) compared to Problem classified heifers. The RIP matrix can be useful for classifying heifers prior to the onset of the breeding season. Further research is needed to evaluate the matrix in other settings and populations of U.S. beef heifers as well as at different intervals between evaluation and the start of breeding season.

1. Introduction

Replacement heifer management is an important contributor and constraint to reproductive efficiency of beef herds. The goal of a replacement heifer program is to bring new, productive animals into the herd that will take the place of non-productive or otherwise less-desirable cows. Beef producers are challenged with the risk of inconsistent yearling heifer reproductive efficiency that can negatively affect herd performance. Developing replacement heifers requires the allocation of scarce resources; therefore, criteria to accurately evaluate reproductive potential of incoming breeding females is important. Early recognition of heifers likely to have sub-optimal reproductive performance improves the efficiency of replacement heifer management.

Heifers not likely to become pregnant early in the breeding season are not desirable as replacements. In addition, heifers that have an increased risk of dystocia due to a pelvis of small size or abnormal shape are also at risk of sub-optimal reproductive performance. Ideally, heifer evaluation should contribute both to the identification of heifers that will negatively affect the herd reproductive efficiency as well as heifers that will perform superiorly due to their physiologic readiness for pregnancy at the beginning of the breeding season and physical conformation that is not associated with increased risk of pregnancy. Several methods have been described that attempt to classify sub-populations of replacement heifer candidates into inferior or superior categories for inclusion in a heifer replacement program [1–12]. However, lack of repeatability, inconvenience, and complexity may limit the widespread use and interpretation of some methods of heifer evaluation.

Puberty is reached when a heifer can express estrous behavior, ovulate a fertile oocyte, and have a corpus luteum with a normal life span. The three main drivers of pubertal onset in heifers are age, body weight, and breed. Age and body weight can be viewed as thresholds where a minimum is necessary, but individual heifer

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fertility does not increase in a linear fashion with additional age and weight, while breed influences the weight and age thresholds [13]. Body condition score (BCS) can also be used as a tool for evaluating and managing replacement heifers [14]. Heifer first-service conception risk improves as BCS increases up to classification 6 [15]. Calving interval is also shorter for cows that calve in higher body condition classification, making BCS an important monitoring tool at calving and breeding [16].

Pelvic area measurement has been used for over four decades to identify heifers with an increased risk of dystocia due to a small or misshaped pelvis [17–19]. The correlation between yearling and two year old pelvic areas is 0.70 therefore yearling pelvic area measurement can be used to predict size of the pelvis at parturition and can be useful to identify heifers that should be culled for not meeting a minimum standard or having a misshapen pelvis [3,13]. However, selection for large yearling pelvic area does not significantly decrease the incidence of dystocia and is a poor predictor of calving difficulty in primiparous cows [20,21]. Pelvic area measurement should be used in concert with other information designed to evaluate heifers for suitability as replacement heifers.

The conventional reproductive tract scoring (RTS) system was developed in the early 1990s at Colorado State University as a tool to assist replacement heifer selection decisions [1]. The system estimates pubertal status and can be used to evaluate heifer development at a group-level and the likelihood of a targeted percentage of the replacement cohort becoming pregnant following estrous synchronization and AI. Reproductive tract scoring is accomplished by transrectal palpation and evaluation of the uterine horns, ovaries, and ovarian structures. A 5-point scoring system is used to describe these findings. Heifers with a tract score of 1, 2, or 3 are considered prepubertal while heifers with a score of 4 or 5 are considered pubertal [1]. The RTS system was validated in 2003 as a repeatable and accurate tool to evaluate pubertal status in beef heifers [22]. Although, due to the subjective nature of the RTS system, risk of misclassifying pubertal heifers as prepubertal can be high for evaluators that lack experience which can limit the ability to predict performance for heifers that have RTS classifications other than 1, especially if no other data is collected to aide in management decisions [22].

Pelvic area measurement combined with RTS evaluation has been shown to be more prognostic for poorly performing heifers than RTS alone [9]. In 2009 Holm et al. compared RTS score to other indicators of reproductive performance (body weight, age, BCS, and Kleiber ratio) to evaluate the system's potential use as a predictor of lifetime production of the heifers. The RTS system compared well with the other evaluated traits when the heifers were followed through their second breeding season [10]. Other studies have shown heifers classified RTS 1 or 2 (prepubertal) were more likely to be in anestrus for the first 24 days of the breeding season independent of pre-breeding BW, age, or BCS than those classified as RTS 4 or 5 (pubertal) [7]. RTS 1 and 2 heifers are also more likely to fail to become pregnant even after adjusting for the anestrus period, and had an increased risk of reproductive failure and removal from the herd at a young age compared to those classified as RTS 4 or 5 [7]. Heifers classified RTS 3 (peripubertal) do not perform significantly better or worse than the other RTS classifications of heifers. RTS classification is an appropriate tool for replacement heifer management if used to exclude heifers that are likely to fail to become pregnant or to calve late in the calving season [7]. Gutierrez et al. evaluated the reproductive efficiency of heifers based on RTS score and showed that heifers with a higher RTS score were able to become pregnant earlier in the breeding season compared with heifers with a lower RTS score [23]. Several researchers have shown that heifers that calve early during their first breeding season will calve early during subsequent breeding seasons and will have increased lifetime production [11,24–27]. Cushman et al. showed that heifers that became pregnant early in the breeding season had better reproductive performance over six parturitions than those that became pregnant later in their first breeding season due to increased longevity in the herd and increased weight weaned [27].

The Ready-Intermediate-Problem (RIP) system is a novel, management-driven matrix that combines the evaluation of body condition, percent mature body weight, reproductive tract score, and pelvic area together to describe the well-being and readiness of potential replacement heifers for breeding. The matrix was designed as an efficient, easily reproducible monitoring step to help veterinarians and producers manage and reduce yearling heifer reproductive inefficiency and thus improve herd reproductive performance. The system stratifies potential replacement heifers into one of three classifications that will predict their ability to positively impact herd reproductive performance by becoming pregnant early in breeding season and having a decreased risk of calving difficulty if bred to an appropriate bull.

If the novel RIP matrix performs as designed, the heifers classified as “Ready” (R) will be suitable for immediate enrollment in AI programs. The heifers classified as “Intermediate” (I) will be suitable replacement heifers but may not be suitable for enrollment in an AI program and depending on the management goals of the producer, may be better suited to a pasture breeding system. The heifers classified as “Problem” (P) will have high risk for failing to become pregnant or to become pregnant late in the breeding season.

The RIP system was designed as a monitoring tool to help veterinarians and producers manage and reduce reproductive inefficiency, but has yet to be evaluated in a research setting. The objective of this study was to evaluate the RIP system's ability to classify heifers into groups that will express different reproductive efficiency outcomes. The outcomes measured will be pregnancy to AI breeding, pregnancy in the first 21 days of breeding season, pregnancy by 21 day cycle, and overall pregnancy percentage. It is hypothesized that Ready and Intermediate classified heifers will outperform Problem classified heifers for all outcomes. Ready heifers will be superior to Intermediate and Problem heifers in AI program performance. And, more Ready classified heifers will become pregnant in the first 21 day cycle than the Intermediate and Problem heifers.

2. Materials and methods

2.1. Animals

The Kansas State University Institutional Animal Care and Use Committee approved the research design and use of heifers in this study (IACUC 3444). This study included 341 yearling heifers from six beef commercial and seedstock producers. The heifers were managed according the replacement heifer development programs of their individual source ranches. In order to qualify for inclusion in the study, the participating producers had to agree to be blinded to the data gathered during the study and to manage all of the heifers within each producers' cohort the same during the study. Data gathered from the producers before evaluation included each heifer's date of birth, individual ID, date of weaning, weaning weight, post-weaning nutrition, and the average mature body weight of the herd. The AI dates, synchronization protocol, and bull exposure dates were also gathered during the study if applicable.

2.2. Description of RIP heifer prebreeding evaluation matrix

Table 1 presents the cutoffs utilized in the Ready-Intermediate-